POWER

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Keep It Clean

WHEN John A. Hill installed his first printing plant, he ordered that the machinery, printing presses and all, should be painted white.

It was an unheard of thing for a print shop, which was proverbially cluttered, ink-besmeared and dirty.

"How am I to keep it clean?" asked the bewildered foreman.

"Don't let it get dirty!" was the reply.

And it stayed immaculate. The first smooch of ink upon the white enameled frame was immediately cleaned off, and knowing that this would have to be done, other smooches that would have accumulated upon an already besmeared machine were avoided.

When a room is clean and well kept and orderly, one hesitates to derange it. He will not throw a handful of clutter upon a well-swept floor nor start to mess up things that are in a spick and span condition.

Things will stay clean a whole lot easier if you don't let them begin to get dirty.

Some men's plants are so clean and neat and quiet running and free from leaks that a little clutter or disorder, a slight pound, a drip of steam or oil or water stands out conspicuous and demands attention. Their machinery looks as nice and runs as well as it did when it was new.

The same principle applies in immaterial things, in one's habits of life, in his thinking. Start with a good clean outfit and don't let it get dirty.

F. R. Low

Power Plant of the First National Bank, Jersey City, New Jersey

THIS article describes a typical small power plant for a modern office building and should appeal to engineers operating other plants of this character. The equipment includes three 3,085-sq.ft. water-tube boilers, hand-fired, operating at 150 lb. pressure and three direct-current generators (total capacity 500 kw.) direct connected to unaflow steam engines. Auxiliaries are both steam and motor driven and are automatically controlled.

THE new building of the First National Bank of Jersey City, N. J., was completed only a few months ago and replaces the old building formerly on the same site. It is ten stories high with a total floor space of 90,000 sq.ft., which includes spacious banking and executive rooms and several floors occupied by business offices, every room of which is amply provided with natural illumination. In the basement is a modern plant supplying light, heat and power. Some of the auxiliary equipment formerly used in the old building has been reconditioned for stand-by or emergency service.

The boiler plant consists of three 3,085-sq.ft. water-tube boilers of the inclined-tube type. There are two drums 36 in. in diameter and 21 ft. 9 in. in length. The shell is of $\frac{3}{8}$-in. plate with double-riveted butt-strap joints and the heads of $\frac{5}{8}$-in. plate. At the rear of the drum is a purifying chamber where the feed water is discharged, and the precipitation of solids and other impurities takes place and settles in the bottom of the chamber. The boilers have 149 lap-welded 4-in. 18-ft. tubes, the two lower rows being of No. 9 gage, all others No. 10. The tubes are inclined $1\frac{5}{8}$ in. per foot of length. Each boiler is fitted with two 3-in. pop safety valves, high- and low-water alarms and mechanical soot blowers. Fusible plugs are inserted in the bottom sheet of the drums in the first pass. The new type key caps are used on the tube headers replacing the usual yoke and bolt type.

The boilers are hand fired, the grates being of the sectional dumping type with a total surface of 59.5 sq.ft., giving a ratio of water-heating surface to grate area of 52 to 1. Turbo blowers are installed at the side of each boiler setting for operating the boilers at higher ratings and to meet bad fuel conditions. The boilers are, however, normally operated on natural draft, this being sufficient for 125 per cent rating.

The generating equipment consists of one 15-in. by 16-in. unaflow steam engine of the auxiliary exhaust-

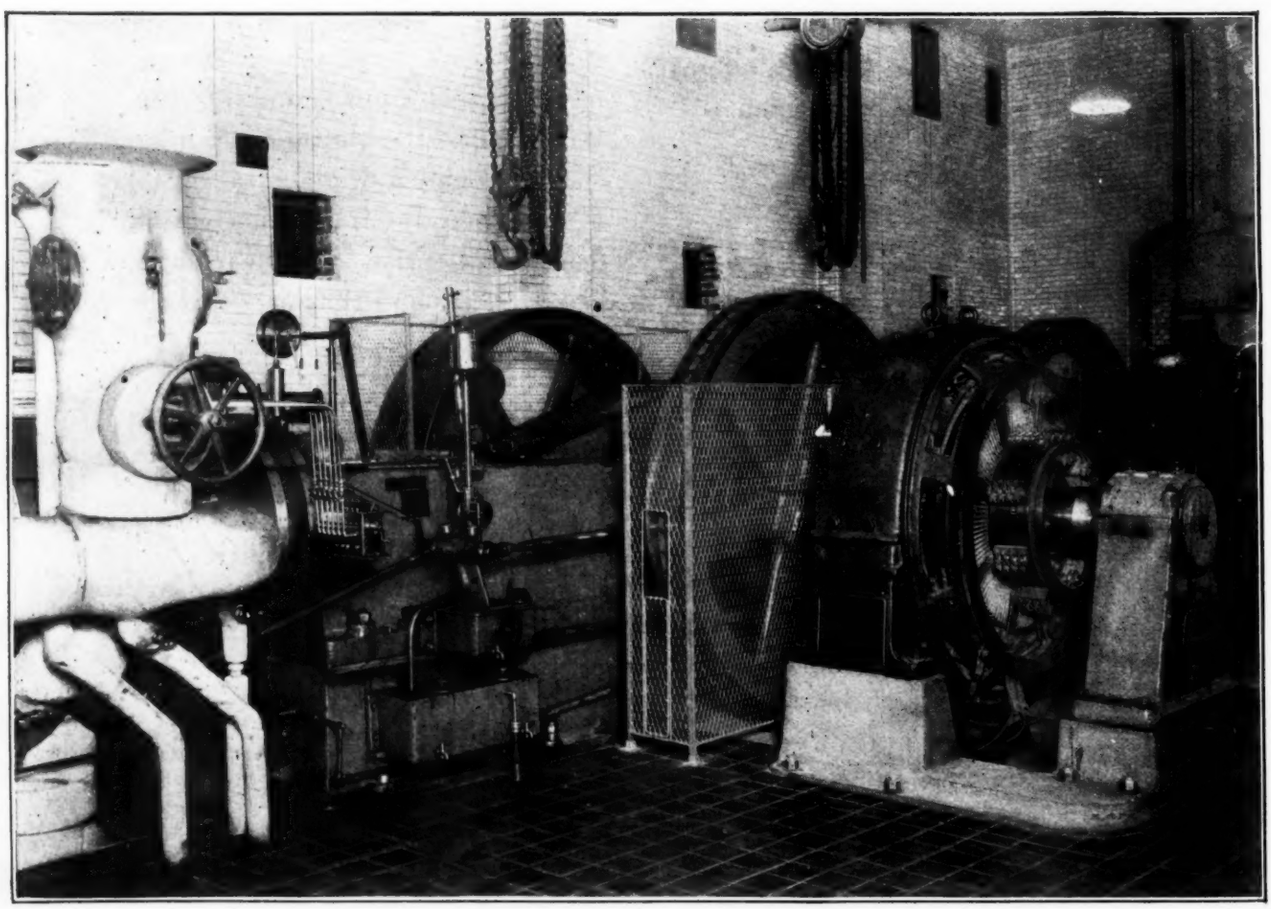
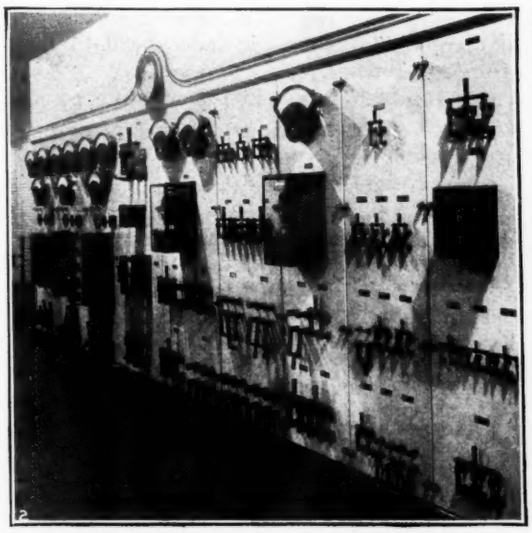
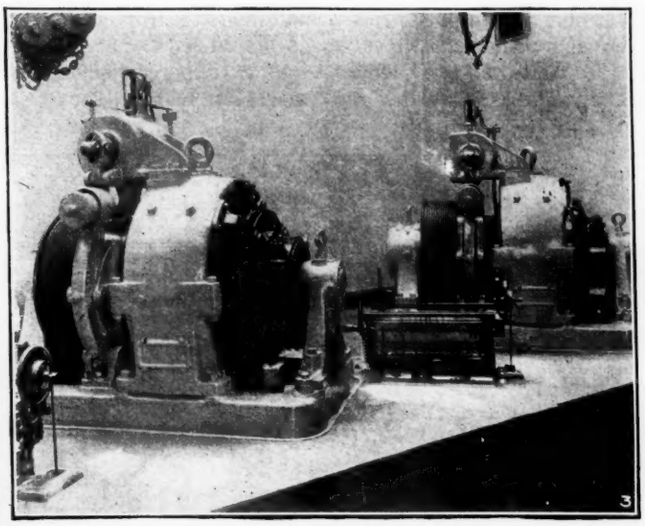


FIG. 1—VIEW OF ENGINE ROOM, SHOWING TWO 200-KW. UNITS

Views of Plant Equipment





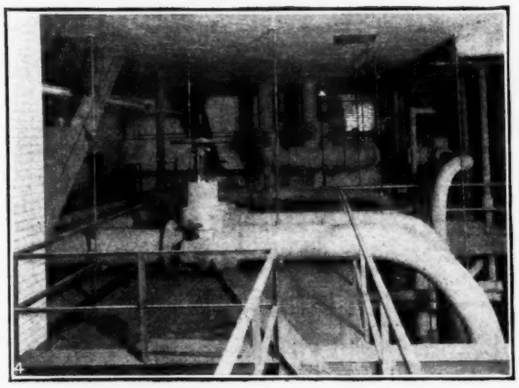


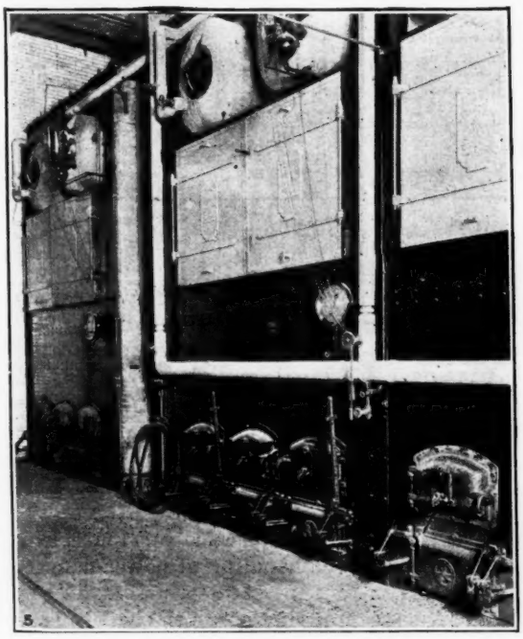
FIG. 2—SWITCHBOARD CONSISTS OF NINE PANELS, TWO PANELS BEING USED FOR ALTERNATING-CURRENT BREAKDOWN SERVICE

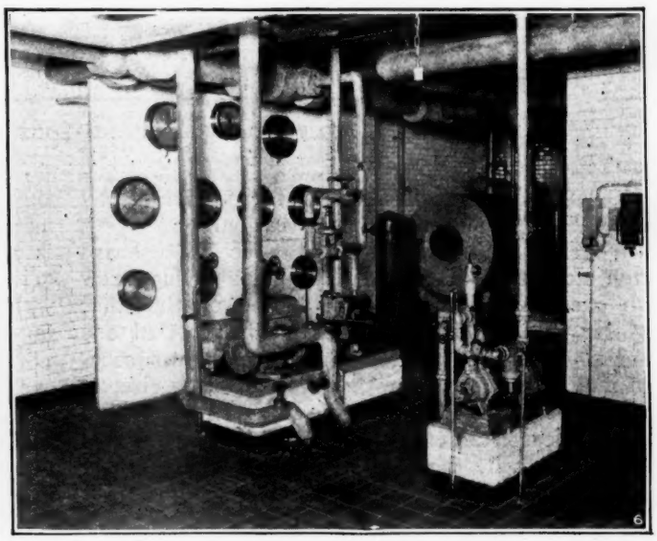
FIG. 3—TWO OF THE THREE HIGH-SPEED PASSENGER ELEVATOR-DRIVING UNITS, LOCATED IN THE PENT HOUSE

FIG. 4—PIPING ABOVE BOILERS. PIPE LINE FROM EACH BOILER IS EQUIPPED WITH ONE NON-RETURN VALVE AND TWO STOP VALVES

FIG. 5—FRONT VIEW OF BOILER INSTALLATION CONSISTING OF THREE 3,085-SQ.FT. WATER-TUBE BOILERS, HAND-FIRED

FIG. 6—SHOWS STEAM- AND MOTOR-DRIVEN VACUUM PUMPS WITH AUTOMATIC CONTROL, ALSO GAGE BOARD AND BLOWDOWN TANK





valve type direct connected to a 100-kw. direct-current generator operating at 260 r.p.m. and two 21x22-in. engines of the same type direct connected to 200-kw. generators of 240-volt three-wire compound-wound interpole type with the compensating coils on the inner end of the armature. These latter units operate at 200 r.p.m. The cylinders are steam-jacketed, the condensation from which is drained through a 1½-in. trap. Each engine is equipped with an automatic stop placed directly above the throttle valve. A steam separator of liberal capacity is provided and, as extra precaution against flooding, is drained by two 1½-in. traps. The count of this service some of the auxiliaries have been duplicated with alternating-current motor drives. Provision has been made in the engine room for a 40-kw. motor-generator set to supplement the stand-by service for the alternating-current motor-driven equipment.

Directly above the crank and armature shaft of the 100-kw. unit is a traveling hoist of 3 tons capacity and above the larger units a 5-ton hoist of the same type. An additional triplex block of 1 ton capacity is located directly above each cylinder head to facilitate inspection and repairs.

The elevator installation in the building consists of

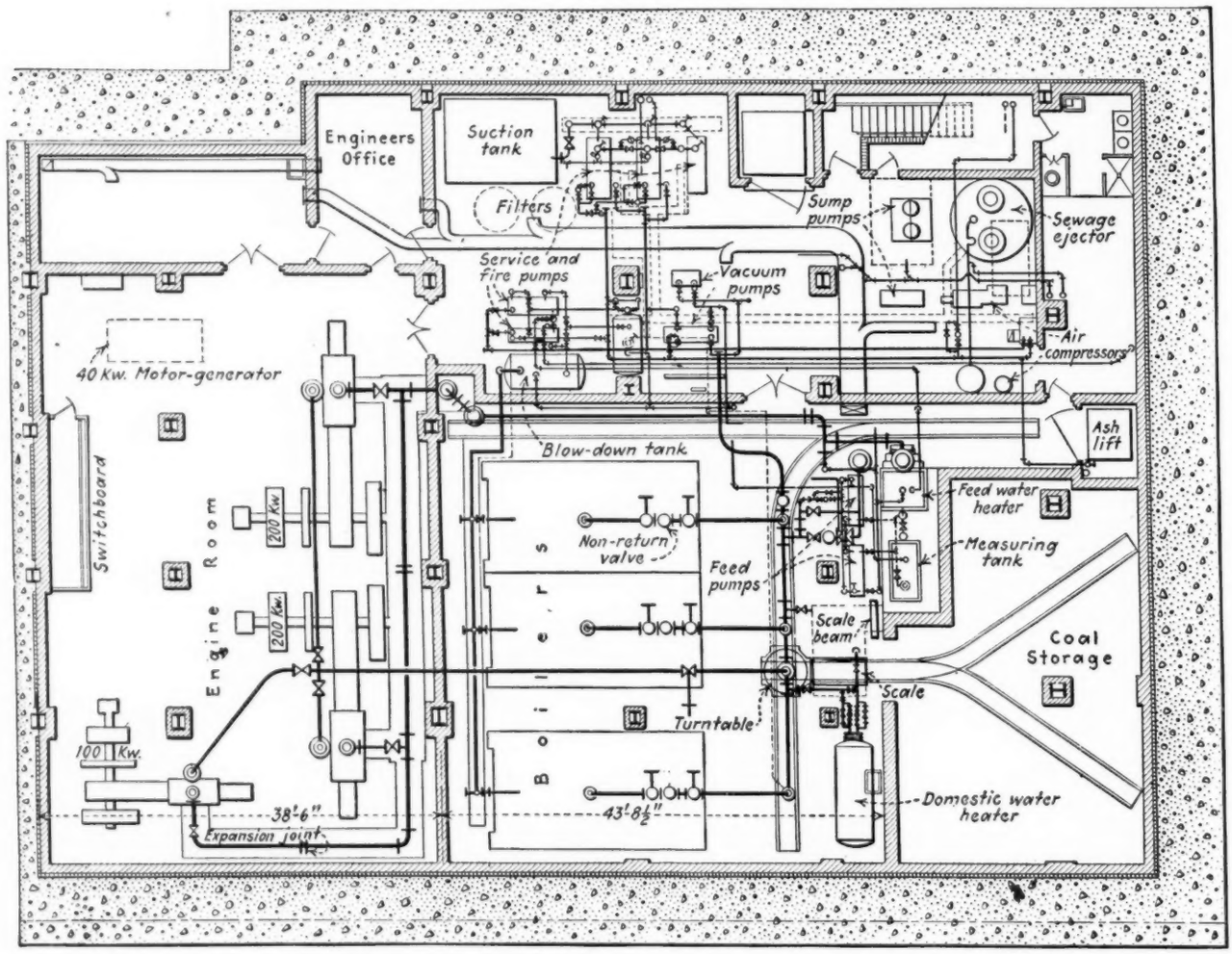


FIG. 7—PLAN SHOWING LAYOUT OF UNITS AND PIPING

selection of unaflow engines was influenced largely by their economical non-condensing operation.

Each generator is connected to the switchboard through a circuit-breaker and a five-blade double-throw switch, one throw being for light and power, the other for power only, making the plant flexible so that one unit or more can be operated on light and power service in multiple or separately as desired. The circuit-breakers have overload and reverse-current relays. The switchboard consists of nine panels of Vermont marble and is equipped with the usual number of indicating and recording meters.

A breakdown service is supplied by the Public Service Corporation, this being 110 volts single phase for lighting and 220 volts two phase 60 cycles for power. On account of this service some of the auxiliaries have been duplicated with alternating-current motor drives. Provision has been made in the engine room for a 40-kw. motor-generator set to supplement the stand-by service for the alternating-current motor-driven equipment.

Directly above the crank and armature shaft of the 100-kw. unit is a traveling hoist of 3 tons capacity and above the larger units a 5-ton hoist of the same type. An additional triplex block of 1 ton capacity is located directly above each cylinder head to facilitate inspection and repairs.

The elevator installation in the building consists of three high-speed passenger elevators, direct-current motor driven. The driving equipment of two of these is shown in Fig. 3. Two medium-speed worm-gear-driven passenger elevators are also installed, one of which is direct-current motor driven and one alternating-current motor driven. There is also one director's car traveling four floors, one push-button money lift operating between the bullion vault and the banking floor, and one gear-driven sidewalk ash lift, so designed as to lift 6 ft. above the sidewalk for the convenient removal of ashes and the handling of power-plant equipment if necessary.

A view of the steam piping above the boilers is shown in Fig. 4. The main steam outlet from each boiler is fitted with extra-heavy gate valves of the outside

screw and yoke type, placed on each side of an automatic non-return valve. The branch from each boiler feeds to a common 12-in. header from which the steam is taken for the generating units and auxiliaries. An auxiliary 3-in. steam outlet is also provided from each boiler and supplies steam for the soot blowers and turbo forced-draft blowers. This also furnishes an auxiliary line to the feed and house service pumps. Long-sweep bends have been used wherever practical. All high-pressure piping above 4-in. diameter is fitted with rolled steel Vanstone joints.

The feed lines are extra-heavy brass pipe throughout, the main line being 3½ in. in diameter with a 2½-in. branch to each boiler. The feed water enters the boilers at the top of the drum at the front end and is carried inside the drum to the purifying chamber at the rear end. A 1½-in. auxiliary feed line connects to the front head of the drums and is used principally for filling and for pumping compound into the boilers.

Two single-cylinder 8x5½x12-in. feed pumps are installed in a convenient location on the boiler-room floor and are controlled by a differential automatic valve.

The exhaust steam from the generating units and auxiliaries passes to the heater and to the main heating header through a 16-in. motor-operated valve and is regulated by a back-pressure valve of the spring toggle type, while the live steam is admitted to this same header under control of a reducing valve of the pilot-valve type, the pressure in the main being variable from atmosphere to 2½ lb. gage.

The building is heated by both direct and indirect systems. The direct system is the single-pipe type fitted with air valves connected to a common air line which is carried down to the pumproom and connected to one 5x7x10-in. steam-driven vacuum pump and one motor-driven air-line pump, both automatically controlled. These pumps, together with the gage board, are shown in Fig. 6. The indirect heating system is connected on the two-pipe system and fitted with thermostatic valves on the discharge, which are in turn connected through a vacuum trap which discharges direct to the returns tank.

All the condensation from the heating system is returned to a circular tank 3x6 ft. located in the boiler room about ten feet above the heater and vented to the atmosphere. From this tank the water flows by gravity to an open heater of 50,000 lb. per hour capacity and then passes through a measuring tank fitted with a V-notch indicating and recording meter to the feed pumps.

The air supplied to the indirect heating system, vault space and banking floor is first passed through an air-conditioning machine fitted with six multiple spray heads and having a capacity of 25,000 cu.ft. of air per minute. The air is afterward tempered through vento-heating stacks of 2,100 sq.ft. and is circulated by a motor-driven multi-blade fan. The section of the building to which this air is supplied is ventilated by a motor-driven fan of 25,000 cu.ft. capacity located in the penthouse. An additional fan of 2,000 cu.ft. capacity is used for ventilating toilets, in vaults and basement space.

The vault is also provided with a self-contained alternating-current motor-driven fan for independent ventilation, the air being discharged through a grating in front of the vault door. It might be mentioned here that the vault is equipped with all the latest electric protective devices and in addition a 2-in. live-steam riot head connected to a valve in the boiler room.

In the fanroom is a motor-driven multi-blade fan of 4,000 cu.ft. per min. capacity, discharging fresh air to engine, boiler and pump rooms and one 6,000-cu.ft. fan exhausting the heated air from the same rooms. There are now being installed to augment this ventilating system one 5,000-cu.ft. fresh-air fan and one 10,000-cu.ft. exhaust fan. These will be operated dur-

DATA ON THE PRINCIPAL EQUIPMENT IN THE POWER PLANT IN THE FIRST NATIONAL BANK, JERSEY CITY

BOILERS

Manufacturer	Union Iron Works
Type	Water-tube
Number installed	3
Water-heating surface per boiler, sq.ft	3,085
Size of tubes, in. diameter	4
Boiler designed pressure, lb. gage	175
Boiler operating pressure, lb. gage	150
Grate area per boiler, sq.ft	59.5
Ratio water-heating surface to grate area	52 to 1

PRIME MOVERS

Manufacturer	Skinner Engine Co
Type	Center-crank, Unaflow, non-condensing
Number installed	3
Capacity, each	One 100-kw. 260 r.p.m., two 200-kw., 200 r.p.m.
Pressure and temperature at throttle	150 lb. saturated steam
Guaranteed performance 100 kw. unit	18.9 lb. per i.hp. full load 18.7 lb. per i.hp. three-quarter load 19.0 lb. per i.hp. at half load 21.0 lb. per i.hp. at quarter load
Type of generator	Direct-current 240-volt
Manufacturer	General Electric Co.

MISCELLANEOUS EQUIPMENT

No.	Equipment	Type	Size	Manufacturer
2	Feed pumps	Single-cylinder	8x5½x12	M. T. Davidson Co.
*2	Fire pumps	Duplex	12x 7x10	Worthington Pump & Machinery Corp.
1	Service pump	3 stage centrifugal 30-hp. motor	2-in.	Yeoman Bros.
2	Service pumps	Single-cylinder	7½x 5x10	M. T. Davidson Co.
1	Vacuum pumps	Single-cylinder	5x 7x10	M. T. Davidson Co.
1	Vacuum pump	Jennings Hytor	1½-in.	Nash Engineering Co.
*2	Drip pumps	Duplex	6x 4x 6	Worthington Pump & Machinery Corp.
*1	Sump pump	Duplex	4½x2½x 4	Worthington Pump & Machinery Corp.
2	Sump pumps	Vertical centrifugal, one a.c. and one d.c. 5-hp. motor driven	.....	Yeoman Bros.

MISCELLANEOUS EQUIPMENT—Continued

No.	Equipment	Type	Size	Manufacturer
1	Air compressor	Motor-driven	5x 4	Ingersoll-Rand Co.
*1	Air compressor	Steam	9½x5½x10	Westinghouse
6	Fans for heating and ventilating	Multiblade	.....	B. F. Sturtevant Co.
1	Air conditioning plant	.....	25,000 cu. ft.	Lynn Air-Conditioning Company
1	Heater	Open	50,000 lb. per hr.	H. S. B. W. Cochrane Corp.
1	Feed-water measurement	V-notch Indicating and Recording meter		H. S. B. W. Cochrane Corp.
3	Turbo-blowers	.....	.....	Garling Turbine Blower Company
2	Sewage ejectors	.....	.....	Shone Co.
	Pop safety valves			Consolidated Valve Co.
	Blowdowns			Everlasting Valve Co.
	Non-return valves			Foster Engineering Co.
	High- and low-pressure valves			Jenkins Bros.
	Back-pressure and reducing valves			Foster Engineering Co.
	Traps, high- and low-pressure			Anderson Co. and P. H. Gill & Sons
	Feed-pump control			Foster Engineering Co.
	Damper control (Curtis)			Julian d'Este Co.
	Pump governor			Ford Regulator Corp.
	Automatic engine stop			Jenkins Machine Co.
	Draft gages			Schaeffer & Budenberg
	Soot blowers, Diamond 5-unit			Power Specialty Co.
	Coal scales			Fairbanks Co.
	Water filters			Loomis-Manning Filter Distributing Co.
	Heat regulation			Johnston Heat Regulating Co.
	Switchboard			General Electric Co.
	All motors (auxiliary drive)			General Electric Co.
	Elevators			Otis Elevator Co.
	Potentiostat system			Usem Co.
	Architect and Consulting Engineer	A. C. Bossom;		
	Electrical Contractor	J. Livingston & Co., Inc.		
	Heating and Ventilation Contractor	W. W. Farrier Co.		

* Old equipment, reconditioned.

ing the summer period as the present equipment is not considered sufficient.

As the building is situated close to the river and the floor of the main basement is approximately 30 ft. below normal tide level, one direct-current and one alternating-current motor-driven pumps are provided to take care of the sumpage. In the event of interruption of the service to either one of these pumps, one 2-in. steam ejector and one 4½x2¾x4-in. duplex pump that were formerly used in the old plant are installed and will be used in emergency only.

The sewerage system from the ground floor down to the lower basement floor is taken care of by two 50-gal. per min. air ejectors automatically controlled. The air for this system and for cleaning purposes around the plant is supplied by one 5x4-in. motor-driven compressor supplemented by one 9½x5½x10-in. steam-driven compressor. Both compressors are automatically controlled and discharge directly to a vertical receiver 4x8 ft. from which an air line is carried to the boiler front for operating a tube-cleaning hammer and to the engine room and penthouse for cleaning motors, etc.

In addition to the pumps already mentioned, there are two 7½x5x10-in. single-cylinder pumps and a motor-driven three-stage centrifugal pump for house service. Two 12x7x10-in. duplex pumps formerly used in the old bank building for elevator service, have been overhauled and are now used for fire pumps and controlled by a pressure regulator, but are fitted with a 1-in. bypass for emergency service. These pumps are also connected so they can be used for house service.

Two 6x4x6-in. duplex pumps formerly used for boiler feed are now utilized as dirty drip pumps on exhaust steam lines and discharge to a heater connected to the hot-water service tank and used as a preheater. This cools the drips before being discharged to the sewer and utilizes the waste heat to heat the cold water before it enters the hot-water service tank. This latter tank is heated by exhaust steam supplemented by live steam under the control of a reducing valve and an automatic heat regulation system. For the heat regulating system one direct-current and one alternating-current motor-driven air pumps are provided, with an auxiliary steam pump for emergency service.

All makeup water, after passing through the house meter, is passed through an independent meter in the boiler room so that the water cost of house and plant can be properly segregated. All feed water as well as the water used in the entire building is passed through two filters in series.

The coal as received is dumped in a scale hopper in the bunker space and weighed by a registering beam scale located in the boiler room. An additional scale is provided for weighing the coal as fired, this being done while loaded in industrial railway cars of 2,000 lb. capacity. These cars have dropping sides and the boilers are fired directly from them. They run on tracks in the boiler-room floor, fitted with a turntable as shown in the plan, Fig. 7. The track also extends to the ash lift for the convenient removal of ashes.

A snow melting and washing equipment is installed. This takes water from the heater at 210 deg., mixes it with cold water through a suction tee and discharges to sill cocks at the sidewalk. This line is also connected to an injector so hot water can be obtained without drawing from the heater.

The boilers are equipped with the necessary draft gages, connected to each pass and to the ashpits; recording thermometers are yet to be put in.

All steam and hot-water lines, as well as other parts of the equipment are well insulated and the auxiliaries and piping have been arranged with a view to accessibility for the operation of valves and for maintenance or repair.

A potentiostat system is provided for operating bells and for automatically controlling the charging and discharging of the storage batteries.

The design and construction of the building was carried on under the direction of A. C. Bossom, architect, and the building superintendent J. P. McKay. The plant is operated under the direction of W. H. Mason, chief engineer.

Why Cylinder Oil Is Compounded

By W. F. OSBORNE
Supervisor, Manufacturers' Service, Texas Co.

STEAM that has not been superheated will carry, by the time it reaches the engine cylinder, moisture in varying amounts. This moisture may have been entrained with the steam as it was evaporated in the boiler, or it may be due to condensation from radiation in its passage from the boiler. Even if the steam were perfectly dry at the time it reached the throttle, it would be wet when it was delivered into the cylinder. Consequently, in all cases where we do not have superheated steam, there is moisture in the cylinder.

Pure mineral oils and water each have about the same ability to wet, or to adhere to, metal. If the metal is wet with water it is difficult to make the oil stick; when it is wet with oil, the water will not displace it readily. However, if a large quantity of water is thrown onto the oil film, or if a considerable number of drops of water strike the oil with considerable velocity, it will have a tendency to scour the oil film off and replace it with a water film. Except in dry steam, the amount of moisture is far greater than the amount of oil present, and the oil film is quite likely to be destroyed entirely.

The washing effect of a small amount of moisture can be overcome to a certain extent by increasing the amount of oil fed to the cylinder and by the use of certain kinds of mineral oils which slightly emulsify with water. For instance, a highly-filtered cylinder oil has little tendency to emulsify, and is of practically no value at all for lubrication where moisture is encountered in large quantity. A refined steam cylinder oil that has not been filtered contains certain constituents that assist in the formation of a slight emulsion in the presence of water, and this emulsion seems to be able to adhere to the metal better than the straight mineral oil. Another explanation is that the unfiltered oil, once on the metal, adheres better than the filtered oil in the presence of water and will not wash off so readily.

The method just outlined is followed where the condensed steam is used for manufacturing purposes, in which the presence of an oil is undesirable. A straight mineral oil can be removed fairly readily from the exhaust steam by suitable separators. A filtered oil can be separated more quickly than a non-filtered oil, and is occasionally used in such installations although a larger quantity is required than of the non-filtered cylinder oil.

Compounding To Withstand Moisture

When the moisture amounts to one-half of one per cent or more, the straight mineral oil has little chance to stand up at all, and it is necessary to add some material that will emulsify with the water, the emulsion being used as the lubricant to a certain extent. General practice is to use tallow oil, raw degras or prepared degras for compounding with mineral oil to take care of such conditions. Sometimes lard oil has been used, but it does not seem to be as satisfactory as tallow oil or prepared degras. The latter oils are equally effective in withstanding moisture.

The amount of compounding necessary depends upon the moisture present, but rarely exceeds ten per cent. The normal amount is about five or six per cent, and where the amount of water is small it can be reduced to three or four per cent. A high percentage of compounding seems to have no advantage whatever over the oil that contains only seven or eight per cent. It is expensive, and there is a greater possibility of sludges and deposits being formed in the lubricators.

When compounded cylinder oils are used, they will withstand the action of the moisture, and a much smaller quantity can be used than if an attempt were made to lubricate the cylinder with a straight mineral oil. The compound lowers the viscosity, improves the atomization and, through the formation of a better film, reduces friction and wear.

Of course when a boiler primes severely and water reaches the cylinder in large quantities, everything is washed off the cylinder wall. If the flow of water continues for any length of time, valves begin to stick, the pistons groan and wear will soon begin. When the water stops, a properly compounded oil will soon form a new film over the cylinder wall and lubrication will continue. If the oil is not suitable it may be quite difficult to get a new film formed before the cylinder or rings have been worn.

Bearing of Character of Oil on Quality of Film

The character of the oil has some bearing on the quality of the oil film, certain oils having the ability to withstand the washing action of the water much better than others. This is particularly true when the water is strongly alkaline, because of boiler compounds or softening treatments. In many plants, trouble is experienced with cylinder lubrication right after a heavy rain. The fresh rain water dilutes the regular source of supply, a creek or river, and each gallon of water delivered by the pumps to the boiler contains less salts in solution than it did before the rain. The engineer, however, sometimes forgets to reduce the amount of boiler compound used, so that the moisture carried over with the steam contains an excessive amount of alkaline boiler compound. This alkali has a saponifying effect on the compounding in the cylinder oil, and it is washed off the cylinder wall by the water.

The remedy is, of course, to prevent the excessive use of boiler compound, and to regulate the amount of salts that the boiler water is permitted to carry.

In some plants, owing to the alkaline nature of the water, it is necessary to blow down the boilers every six hours to prevent priming. In other plants, the boilers are not blown down as often as they should be, and the salts in the boiler water increase to such a point that priming starts, and the hightly alkaline water is carried over to the cylinders, where it destroys the oil film.

Effect of Receiver in Removing Compounding

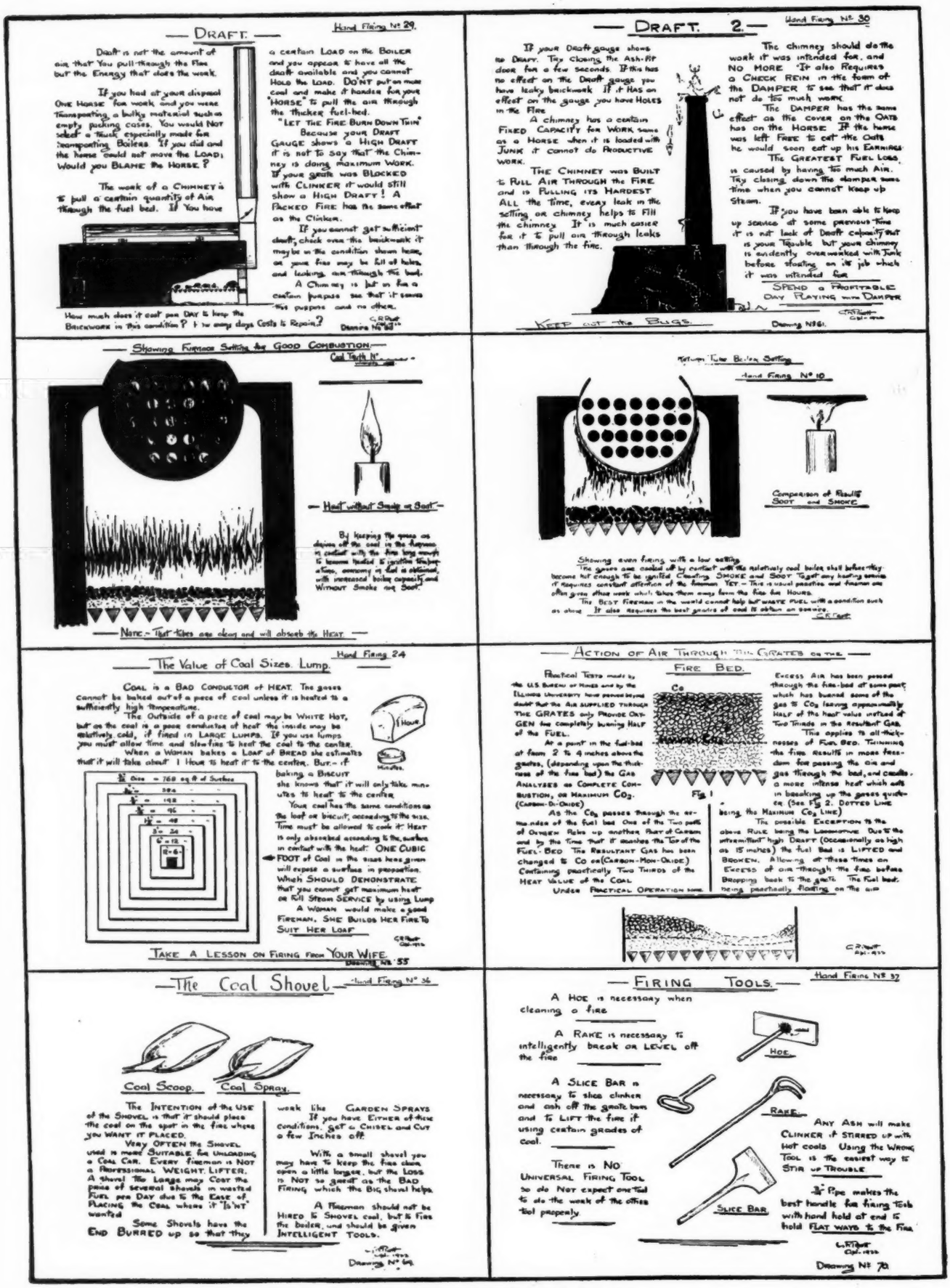
Another point that must be watched carefully on certain installations is the effect of the receiver of a compound engine in removing the compounding from the oil going to the low-pressure cylinder. During the passage of the oil through the high-pressure cylinder, where it has been received in a highly atomized condition, a certain amount of condensation and emulsification takes place. The compounding is dissolved or separated from the cylinder oil in some manner, and when the condensate is removed from the steam in the receiver, it carries with it a large part of the compounding that was originally in the oil. The oil that passes on to the low-pressure cylinder is low in compounding.

The low-pressure cylinder, on account of its low temperature and the amount of moisture present in the steam, requires a well-compounded oil. It is then necessary to feed considerable quantities of oil into the low-pressure cylinder in order to lubricate it at all. When the steam leaving the high-pressure cylinder is fairly dry, owing to the steam having been initially superheated, very little compound is removed from the oil, and the low pressure cylinder is much easier to lubricate.

Before leaving the question of moisture, it might be well to point our the fact that the cylinders of many steam engines in marine service are never lubricated at all. These engines have vertical cylinders; there is little pressure on the cylinder walls at any point, and engineers have found that so long as the steam contains a little moisture, it will serve as a lubricant and keep the cylinders in good condition without wear. This is particularly desirable for salt water service because of the elimination of boiler troubles which might be caused by the presence of oil in the condensate returned to the boiler.

Engineering, as distinguished from guesswork, is based on carefully collected facts. The designing engineer must know his materials unless he is content to learn by a series of accidents. So the testing of materials has become an important branch of engineering, and new types of testing machines are constantly making their appearance. In the field of metal testing alone we now have machines for making tests of tension, compression, shear, hardness, torsion, resistance to impact, elasticity, combined stresses, fatigue, abrasion, etc.

Carbon dioxide is sometimes thought to be a poison because fatalities have occurred from accumulations in mines and wells. As a matter of fact deaths from this cause are really due to suffocation or "drowning." Carbon monoxide, on the other hand, is an active poison that attacks the blood.


— DRAFT. —
Hand Firing No 29.
Draft is not the amount of air that You pull through the Fire but the Energy that does the work.
If you had at your disposal One Horse for work and you were Transporting a bulky material such as empty packing cases. You would Not select a Truck especially made for Transporting Boilers. If you did and the horse could not move the Load; Would you Blame the Horse?
The work of a Chimney is to pull a certain quantity of Air through the fuel bed. If You have a certain Load on the Boiler and you appear to have all the draft available and you cannot Hold the Load. Don't put on more coal and make it harder for your "Horse" to pull the air through the thicker fuel-bed.
"Let the Fire Burn Down Thin"
Because your Draft Gauge shows a High Draft it is not To Say that the Chimney is doing Maximum Work. If your grate was Blocked with Clinker it would still show a High Draft! A Packed Fire has the same effect as the Clinker.
If you cannot get sufficient draft, check over the brickwork it may be in the condition shown here, or your fires may be full of holes and leaking air through the bed.
A Chimney is but in for a certain purpose see that it serves this purpose and no other.
How much does it cost per Day to keep the Brickwork in this condition? How many days Costs to Repair?
Drawing No 61
— DRAFT. 2. —
Hand Firing No 30
If your Draft gauge shows no Draft. Try closing the Ash-Pit door for a few seconds. If this has no effect on the Draft gauge you have leaky brickwork. If it Has an effect on the gauge you have Holes in the Fire.
A chimney has a certain Fixed Capacity for Work some as a Horse when it is loaded with Junk it cannot do Productive work.
The Chimney was Built to Pull Air Through the Fire and is Pulling its Hardest All the Time, every leak in the setting or chimney helps to Fill the chimney. It is much easier for it to pull air through leaks than through the fire.
The chimney should do the work it was intended for, and No More. It also Requires a Check Rein in the form of the Damper to see that it does not do too much work.
The Damper has the same effect as the cover on the Oats has on the Horse. If the horse was left Free to eat the Oats he would soon eat up his Earnings.
The Greatest Fuel Loss is caused by having too much Air. Try closing down the damper some time when you cannot keep up Steam.
If you have been able to keep up steam at some previous Time it is not lack of Draft capacity but is your Trouble but your chimney is evidently overworked with Junk before starting on the job which it was intended for.
Spend a Profitable Day Playing with Damper
Keep out the Bugs.
Drawing N°61.
— Showing Furnace Setting for Good Combustion —
Coal Teeth N°
— Heat without Smoke or Soot —
By keeping the gases on deposited coal in the furnace in contact with the fire long enough to become heated & ignition takes place, economy of fuel is obtained, with increased boiling capacity and Without Smoke or Soot.
Note — That flues are clean and will absorb the Heat.
Return Tube Boiler Setting
Hand Firing N° 10
Comparison of Results Soot and Smoke
Showing even firing with a low setting. The gases are cooled off by contact with the relatively cool boiler shell before they become hot enough to be ignited. Clinkering, Smoke and Soot. To get any heating service it requires constant attention of the fireman. Yet — This is usual practice and fireman are often given other work which takes them away from the fire for Hours.
The Best Fireman in the world cannot help but waste Fuel with a condition such as above. It also requires the best grades of coal to obtain an economy.
— The Value of Coal Sizes. Lump. —
Hand Firing 24
Coal is a Bad Conductor of Heat. The gases cannot be baked out of a piece of coal unless it is heated to a sufficiently high temperature.
The Outside of a piece of coal may be White Hot, but as the coal is a poor conductor of heat the inside may be relatively cold, if fired in Large Lumps. If you use lumps you must allow time and slow fires to heat the coal to the center.
When a Woman bakes a Loaf of Bread she estimates that it will take about 1 Hour to heat it to the center. But — if baking a Biscuit she knows that it will only take minutes to heat to the center.
1 Hour
Minutes.
Your coal has the same conditions as the loaf or biscuit, according to the size. Time must be allowed to cook it. Heat is only absorbed according to the surface in contact with the heat. One Cubic Foot of Coal in the sizes here given will expose a surface in proportion. Which Should Demonstrate that you cannot get maximum heat or Full Steam Service by using Lump.
A Woman would make a good Fireman. She Builds her Fire To Suit Her Loaf
Take a Lesson on Firing from Your Wife.
Drawing No. 55
— Action of Air Through the Grates on the Fire Bed. —
Practical Tests made by the U.S. Bureau of Mines and by the Illinois University have proved beyond doubt that the Air supplied through the Grates only Provide Oxygen for completely burning Half of the Fuel.
At a point in the fuel-bed at from 2 to 4 inches above the grates, (depending upon the thickness of the fuel bed) the Gas Analyses as Complete Combustion, or Maximum CO_2. (Carbon-Di-Oxide)
As the CO_2 passes through the remainder of the fuel bed One of the Two parts of Oxygen Robs up another Part of Carbon and by the Time that it reaches the Top of the Fuel-Bed The Resultant Gas has been changed to CO or (Carbon-Mon-Oxide) Containing practically Two Thirds of the Heat Value of the Coal
Under Practical Operation some Excess Air has been passed through the fire-bed at some point, which has burned some of the gas to CO_2 leaving approximately Half of the heat value instead of Two Thirds in the resultant Gas.
This applies to all thicknesses of Fuel Bed. Thinning the fires results in more freedom for passing the air and gas through the bed, and causes a more intense heat which aids in breaking up the gases quicker. (See Fig 2. Dotted Line being the Maximum CO_2 Line)
The possible Exception to the above Rule being the Locomotive. Due to the intermittent high Draft (Occasionally as high as 15 inches) the fuel Bed is Lifted and Broken. Allowing at these times an Excess of air through the fires before Dropping back to the grate. The fuel bed being practically floating on the air
Fig 1
— The Coal Shovel —
Hand Firing N° 36
Coal Scoop. Coal Spray.
The Intention of the Use of the Shovel is that it should place the coal on the spot in the fire where you Want it Placed.
Very Often the Shovel used is more Suitable for Unloading a Coal Car. Every Fireman is Not a Professional Weight Lifter. A shovel Too Large may Cost the pens of several shovels in wasted Fuel per Day due to the Ease of Placing the Coal where it "Is'nt" wanted
Some Shovels have the End Burred up so that they work like Garden Sprays If you have Either of these conditions, get a Chisel and Cut a few Inches off.
With a small shovel you may have to keep the fires clean open a little longer, but the Loss is Not so great as the Bad Firing which the Big shovel helps.
A Fireman should not be Hired to Shovel coal, but is Fires the Boiler, and should be given Intelligent Tools.
Drawing N° 64
— Firing Tools. —
Hand Firing N° 37
A Hoe is necessary when cleaning a fire
A Rake is necessary to intelligently break or Level off the fire
A Slice Bar is necessary to slice clinker and ash off the grate bars and to Lift the fire if using certain grades of coal.
There is No Universal Firing Tool to do. Not expect one Tool to do the work of the other Tool properly
Hoe.
Rake.
Slice Bar
Any Ash will make Clinker if Stirred up with Hot coals. Using the Wrong Tool is the easiest way to Stir up Trouble
A Pipe makes the best handle for fixing Tools with hand hold at end to hold Flat ways to the Fire.
Drawing N° 70

Suggestions for Hand Firing

Reproduced from slides employed in educational work of the Mines Branch, Province of Alberta, Canada. Submitted by G. R. Pratt

Alignment of Diesel Connecting Rods

By G. Grow

The writer was at one time employed by a corporation that had in a number of plants a total of over forty Diesel engines. There had been no intelligent supervisor of the plant operations, nor had any great attempt been made to keep the engines in shape. As a result many of them were running with worn main and connecting-rod bearings, as well as with frozen piston rings and low compression.

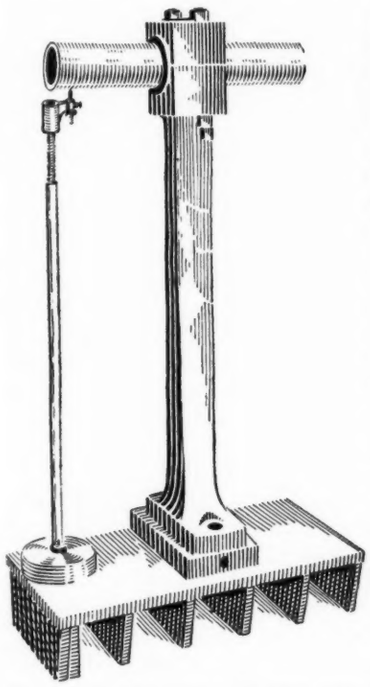


FIG. 1. GAGE FOR TESTING CONNECTING ROD

It was necessary to inaugurate a system of overhauling every engine owned. To do this, each plant was taken up in turn and one engine was dismantled and tuned up before the second was touched save for running adjustments.

A number of tools were made to meet certain requirements in the work, but of especial interest was the method of checking the connecting-rod bearings. The piston pins, and in case of crosshead-type engines the crosshead pins, were in some of the engines fitted with bronze boxes. The crankpin bearings were all babbitted. On almost all the engines it was necessary to rebore and refit the piston-pin bearings and to rebabbitt and refit the crank bearings.

The bronze bearings were filed at the joints, packed with about 0.005 in. of shims and rebored. Small cross-grooves were then cut into the lower half.

The crank bearings were cleaned of all old babbitting, tinned and rebabbitted. Following this the bearings were rebored. It happened that there were but three crank-pin diameters on all the engines and so mandrels were turned up made of extra-heavy Shelby seamless steel tubing of the correct diameter, finished smooth and true by polishing. The bearings were scraped to fit these mandrels.

Since there was no assurance that the piston-pin and crank-pin bearings were in alignment, it was necessary to make some gage by which the rods could be checked. A cast-iron plate was finished-up smooth by planing and provided with two slots. The connecting rod was placed on this plate and held down by two bolts in the slots. The piston-pin mandrel was placed in the bearing and the bronze shells drawn snug. A gage was made of a 4-in. brass disk into which was screwed a $\frac{3}{4}$-in. drill rod. The upper end of the rod was threaded to receive a thimble having a pointed end. This gage was set on the plate, Fig. 1, and the thimble adjusted until the point just touched the bottom of the mandrel. Moving it to the other side of the connecting rod the height of the mandrel above the plate was measured, and if it was the same, then the piston pin was in alignment with the butt end of the connecting rod. To have the two pins parallel, the crankpin must be parallel with the butt face of the bearing housing. This was checked by placing the bearing on the surface plate referred to and by using a surface gage, Fig. 2. The mandrel height was checked at both ends. In a few cases we found that the bearing bore was not parallel with the butt face. This was no doubt the reason for the belling of the bearings.

To check the rod to see if the two pins were in the same plane, the rod was assembled with the mandrels in place. The crank end was leveled by packing pieces, using the surface gage on the mandrel to find the correct position. The other end was supported by a block and the piston-pin mandrel checked at each end, Fig. 3. In only one rod was there a discrepancy, and this has always been the hardest engine to keep running.

The engineer in charge of one or two engines may think this an expensive method, but the cost is nominal;

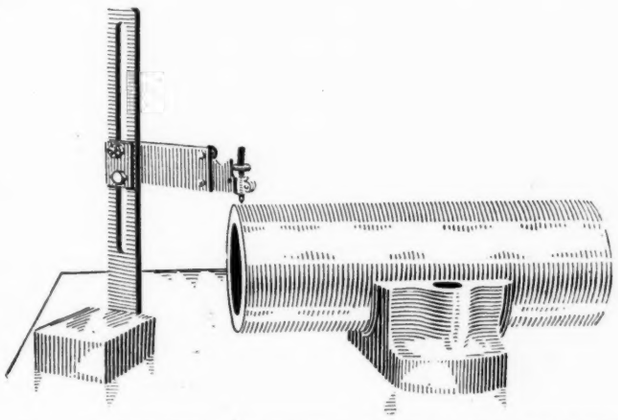


FIG. 2. CHECKING ALIGNMENT OF CRANKPIN BEARING

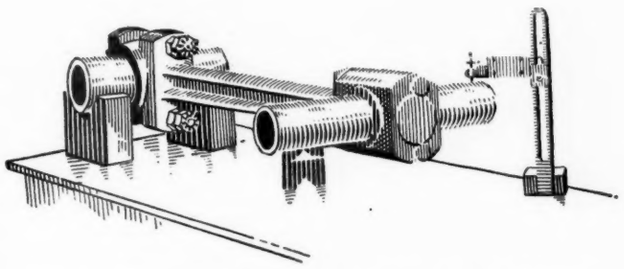


FIG. 3. FINDING IF THE TWO PINS ARE PARALLEL

the planing of the plate and making the gage cost less than $25.

If an internal-combustion engine is to run right, it must be kept in shape. This requires no more skill than in case of a steam engine or turbine.

The question as to how heavy a fuel may be used in the oil engine is still open. In the early days of development the heavy oil engine was supplied with a light distillate such as kerosene. Improvements in combustion have been such that at present most of the modern engines will burn a petroleum as low as 12 deg. Baumé while many are running on tar oil.

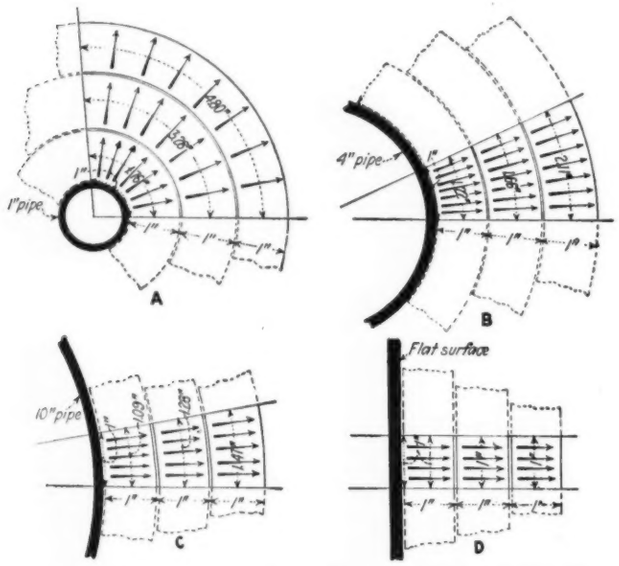
Why Larger Pipes Take Thicker Coverings

1. What determines thickness in any case.
2. How curvature affects the cost and value.
3. Table of most economical thicknesses.

EVERY engineer is familiar with the fact that it is customary to use thicker heat insulation on larger pipes. There is a sound economic reason for this.

In the first place, let us consider what determines the thickness of covering in any case. The idea will be a little easier to get by assuming an imaginary state of affairs. Suppose it were practicable and customary to sell pipe covering in very thin layers, say ¼-in. thick, and that the price of a given thickness made of several ¼-in. layers was the same as the actual present price of a single layer of the same total thickness. Also, assume that the total application cost is the same for several thin layers as for one thick one of the same total thickness.

Now let us assume that the life of insulation, the



OUTER LAYERS ARE WORTH MORE AND COST LESS ON FLATTER SURFACES

rate of interest and other conditions are such that anything that will pay for itself in, say, eight years is worth buying. An imaginary salesman arrives with a supply of many layers of insulation and offers to sell the imaginary purchaser as many layers as he wishes. The purchaser decides to buy the insulation one layer at a time and to keep on as long as there is any advantage in doing so.

He starts by buying the first ¼-in. layer. This, going directly on the bare pipe, pays for itself in an exceedingly short time, say one week. There is no question about the desirability of this investment. Having put the first ¼-in. on the pipe, the next ¼-in. layer has less opportunity to save heat, since the pipe covered with the first layer is equivalent to a cooler bare pipe ¼-in. larger. Although the opportunity for saving is less, it is still very high. Suppose the second layer will pay for itself in four weeks. The buyer sees that it is a fine bargain and takes it. Then he is offered the third layer which is to pay for itself in twelve weeks. This, again, is an excellent bargain and he takes it.

So he keeps on buying layer after layer, each succeeding layer being a poorer bargain than the one before, but still worth taking, until the point is reached where he is offered a layer that will take eight years to pay for itself. Then he will stop, because under his particular conditions he does not care to buy any insulation that will not pay for itself in eight years.

The reader should note that the thickness is based, not on the time it takes the whole insulation to pay for itself, but on the time it takes the last thin layer. The total thickness determined in the manner just described is called the economic thickness and is that which is the best investment. It should also be particularly noted that, although the last thin layer may take several years to pay for itself, the covering as a whole, when of the economic thickness, ordinarily pays for itself in a few months.

Although, in practice, pipe covering is generally applied in one or two layers only, the total price depends on the total thickness just as if it were made up of a lot of thin layers. In the case of flat blocks applied to a flat surface, the cost will ordinarily go up in exact proportion to the thickness. Covering twice as thick will cost twice as much. In the case of a pipe or curved surface, however, the price will increase more rapidly than the thickness.

In the diagram *A* shows the amount of insulating material required to cover 1 in. of the circumference of a 1-in. pipe with various thicknesses. The first inch-thick layer has an average width along the arc of 1.76 in., and the material required to cover 1 in. of pipe circumference will have a cross-sectional area of 1.76 sq.in. The fact that 1.76 sq.in. is required, instead of 1 sq.in., does not mean that there is more insulating effect. As a matter of fact, there is less.

This is so because the increase in material does not increase the *distance* through which the heat must pass, but increases the *area*. It is much like discharging air or water through a sieve placed on the flared end of a pipe. If the cross-sectional area of the sieve is increased, the resistance to the flow of water or air is reduced.

When the second inch of thickness is added, the purchaser must pay for 3.28 sq.in. of insulation and receive less in return than if he bought 1 sq.in. with a flat surface. In the same way the third inch of thickness requires 4.80 sq.in. of cross-section to cover one inch of arc on the pipe.

B gives the corresponding figures for a 4-in. pipe. Here again each succeeding 1-in. thick layer is larger than the one before, but the rate of increase is less than for the 1-in. pipe The three successive layers have an average width of 1.22 in., 1.66 in. and 2.11 in. In this instance it is obvious that the thickness could be increased more than in the case of the 1-in. pipe

before the point was reached where a slight increase would barely be worth while. Of course the actual location of this point in any case depends also on the price of coal and other considerations.

When insulation is applied to a 10-in. pipe, as shown at *C*, the "flaring" effect due to curvature is much less pronounced, the average widths of the three 1-in. layers being respectively 1.09 in., 1.28 in. and 1.47 in. So the most economical covering for a 10-in. pipe is thicker than that for a 4-in. pipe, in the same way as that for the 4-in. pipe is greater than that for a 1-in. pipe. Moreover, a 20-in. pipe would theoretically take a greater thickness than a 10-in. However, as the size of the pipe increases, the curvature changes more and more slowly, so that the increase in thickness from a 10-in. pipe to a flat surface is small.

The condition for a flat surface is shown at *D*. Here each successive 1-in. layer to cover a strip 1 in. wide has a cross-section of 1 sq.in., hence each costs the same as the one before. It still remains true, however, for the reason stated at the beginning of this article, that each successive layer does less good than the one before. Finally, a point is reached where any further saving, due to an increase in thickness, would cost as much as it would be worth. The thickness at which this occurs is the most economical.

The accompanying table[1] gives the economic thickness (nearest commercial size) of 85 per cent magnesia pipe covering for various pipe sizes, steam conditions and coal prices. It is based on average figures for boiler efficiency, heating value of coal and cost of insulation applied. The pipes are assumed to contain steam continuously.

ECONOMIC THICKNESS (IN INCHES) OF 85 PER CENT MAGNESIA PIPE COVERING

Size Pipe, In.	Hot Water 175 Deg. F.	Steam 5 Lb.	Steam 100-200 Lb.	200 Lb. 150 Deg. F. Superheat,	Hot Water 175 Deg. F.	Steam 5 Lb.	Steam 100-200 Lb.	200 Lb. 150 Deg. F. Superheat
	Coal at $2 Per Ton				*Coal at $4 per Ton*			
¾	S	S	S	1½	S	S	1½	DS
1½	S	S	S	1½	S	S	1½	DS
3	S	S	S	1½	S	S	DS	DS
6	S	S	1½	2	S	1½	DS	3
12	S	S	1½	2	S	1½	DS	3½
24	S	S	2	3	S	1½	DS	3½
Flat	1	1½	2	3	1½	2	3	4
	Coal at $6 per Ton				*Coal at $8 per Ton*			
¾	S	S	DS	2	S	1½	1½	2
1½	S	1½	DS	2	S	1½	2	3
3	S	1½	DS	3	1½	2	3	3
6	1½	2	DS	3	1½	2	3	4
12	1½	2	DS	4	2	3	3	4
24	1½	2	DS	4	2	3	4	5
Flat	2	3	4	5	2½	3½	4½	6

Note: In the table "*S*" means "standard thick" which ranges from ¾ in. for pipes smaller than 2 in. up to 1½ in. for pipes larger than 10 in. "*DS*" means "Double Standard," that is, two standard-thick layers. The 3-in. covering ordinarily comes in two 1½-in. layers.

Yarway Involute Spray Nozzle

A type of spray nozzle having no internal parts, vanes or deflecting plates, is shown in Fig. 1. This nozzle is unique in the design of its spray chamber. The water, in passing through this chamber, travels in an involute path toward the circular orifice, which is located exactly at the center of the involute. Receiving the water at constant velocity on all sides, the orifice discharges it in a finely divided conical spray. The absence of internal parts makes for simplicity and freedom from clogging. The nozzle is the invention of W. H. Klein, superintendent of the Dixie Portland Cement Co., Richard City, Tenn.

[1]From a table prepared by the Mellon Institute of Industrial Research, University of Pittsburgh.

Both single and double nozzles of the involute type are made, the latter size providing a much larger capacity than the single type. For 2-in. pipe connections, at 7 lb. per sq.in., the single nozzle will deliver

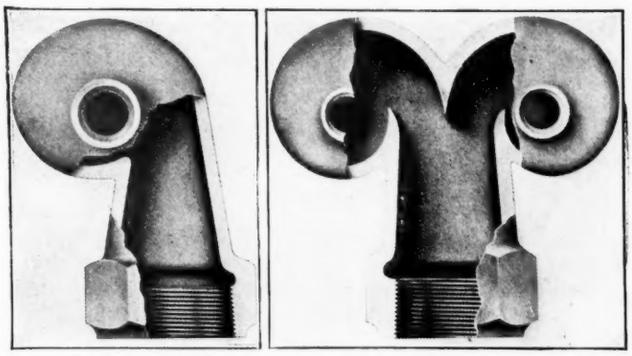


FIG. 1—YARWAY SINGLE AND DOUBLE INVOLUTE SPRAY NOZZLES

30 gal. per min., while the double nozzle will handle 47 gallons.

Recently placed on the market by the Yarnall-Waring

TABLE I. TESTS ON YARWAY SINGLE NOZZLE
(W. H. Klein type)

Pressure, Lb. per Sq.In.	T_1	T_2	T_1-T_2	T_w	T_d	Efficiency Per Cent
5	114.2	85.5	28.7	67.8	79.8	61.8
6.96	120.5	81.9	36.6	68.2	79.2	73.8
9.9	114.6	83	31.6	68.5	80.2	68.1
9.9	99.6	78.5	21.1	70.3	78.8	53.7
6.96	100.2	80.3	19.9	69.8	78.9	55.5

TABLE II. TESTS ON YARWAY DOUBLE NOZZLE
(W. H. Klein type)

Pressure, Lb. per Sq.In.	T_1	T_2	T_1-T_2	T_w	T_d	Efficiency, Per Cent
9.51	110.6	79.2	31.4	67.3	78.8	70.2
6.99	107.6	83.2	24.4	69.5	80.9	63.4
5.1	110.2	88.6	21.6	69.6	81.0	53.2

T_1 = temperature water entering nozzles, deg. F.; T_2 = temperature water leaving pond; T_1-T_2 = cooling range; T_w = wet-bulb temperature; T_d = dry-bulb temperature; $\frac{T_1-T_2}{T_1-T_w}$ = cooling efficiency.

Co., Chestnut Hill, Philadelphia, the nozzle was first subjected to a year's trial at the Dixie Portland Cement Co.'s plant. The spray pond, shown in Fig. 2, is equipped with 183 2-in. spray heads of the single type with ¾-in.

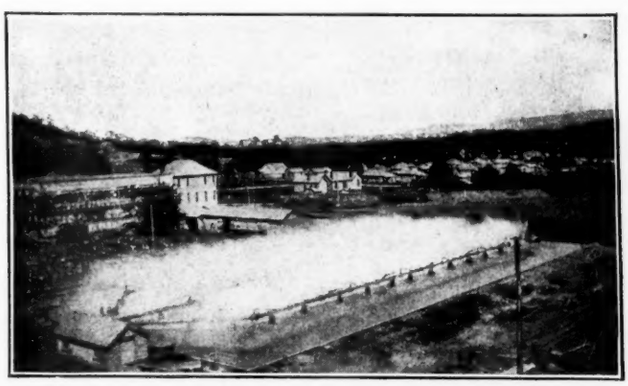


FIG. 2—SPRAY POND OF DIXIE PORTLAND CEMENT CO., USING SINGLE INVOLUTE NOZZLES

orifice, and has a capacity of 4,500 gal. per min. at 7 lb. pressure.

Tables I and II show the degree of cooling obtained with both single and double types in a series of tests run at Johns Hopkins University, Baltimore, Md.

Considerations in Laying Out Motor Circuits

How To Lay Out and Make a Motor Installation That Is Safe and Reliable—Construction of a Motor Panel Board Is Explained, and Tables for the Sizes of Wires, Switches, Fuses and Conduits Are Given

BY MARIN PHILLIPS

IN PLANNING and laying out electrical power equipment there are many things to take into consideration. The planning of a new installation should be carried out with the following points in mind: (1) To make the installation as safe and accessible as possible. (2) To keep the expense down as much as possible and still have a good layout. (3) The most economical centers of distribution. (4) How much over-capacity should the main feeders have? (5) The number of main feeders to run. (6) Should all wiring be in conduit? (7) To locate the equipment so that it will not be in the way of other machinery. (8) To purchase equipment that will require the least maintenance work after the installation is completed.

(1) To make the installation safe electrically for the operators, there must be as few live parts exposed as possible; and to make it safe for the maintenance men while changing fuses and making repairs, it must be accessible, so that it will not be necessary to climb ladders, or work in close, dangerous places.

(2) If only the first cost is considered in laying out the installation, the least expensive is likely to prove to be the most costly in the end. Frequently, a list of materials needed is submitted to different manufacturers, but no requirements are stated as to the quality of the material or the exact condition that it will have to operate under. The one who can furnish the lowest bid, usually gets the order, without any consideration as to its quality or the expense for the upkeep after it is installed. The cost of maintenance is worthy of consideration, since it may be only a small amount compared with the time lost in production by the machines when shut down while repairs are being made. Starting boxes for the motors are important, and should be selected with care with the following points in mind:

How long will it take to change the contacts? Are all the contacts made accessible by removing the cover? Are any of the contacts so located that the starter will have to be taken apart to get to them? And will the parts be interchangeable for three or four different sizes, so as to reduce the number of spare parts to be carried in stock to a minimum?

It is not uncommon for a 10- or 15-hp. starting box to be part of a drive for a machine that is producing $100 or $200 worth of material per hour; consequently every minute counts when the starter is out of service. A starting equipment with all contacts in plain view when the cover is removed may cost $125, and another one of the same capacity with inaccessible contacts will cost $100. It is evident that the latter will require more time in locating trouble and making repairs, and the extra cost may soon amount to more than the difference in price of the two starters. The tripping mechanism should not be so sensitive as to trip out from vibration, causing unnecessary shutdowns.

When the expense is the only thing that is taken into consideration, the main feeders are frequently run leaving junction boxes at places where it is decided to tap off for a motor circuit, and another junction box with fuses in it mounted alongside of this, with a line run from there to the starting box for the motor. This arrangement has a number of objections. First, it is a difficult job to make splices in a junction box and solder them properly without damaging the insulation. A burnout comes to mind that occurred recently in a junction box which was part of a new installation that had been in operation about two months. Two of the wires grounded on a bushing, damaging them beyond repair. This required taking the conduit apart, taking off two lengths and making temporary repairs to the wire, thus holding up a machine for two hours at a loss of product having a value of over $400. It is evident

TABLE I—WIRING DATA FOR FOUR-WIRE TWO-PHASE SQUIRREL-CAGE MOTORS

	Full Load Amperes				Starting Fuse, Amperes				Running Fuse Amperes				Switch Size, Amperes				Size of Wire				Size of Conduit			
	110	220	440	550	110	220	440	550	110	220	440	550	110	220	440	550	110	220	440	550	110	220	440	550
HP	Volts	Volts	Volts	Volts	Volts	Volts	Volts	Volts	Volts	Volts	Volts	Volts	Volts	Volts	Volts	Volts	Volts	Volts	Volts	Volts	Volts			
0.5	3.1	1.5	0.8	0.6	10	5	5	5	5	5	5	5	30	30	30	30	14	14	14	14	¾	¾	¾	¾
1	6	3	1.5	1.1	15	10	5	5	10	5	5	5	30	30	30	30	14	14	14	14	¾	¾	¾	¾
2	11	5.6	2.8	2.2	30	15	10	5	15	10	5	5	30	30	30	30	10	14	14	14	1	¾	¾	¾
3	14.7	7.3	3.6	3.2	40	25	15	10	20	10	5	5	60	30	30	30	8	12	14	14	1¼	¾	¾	¾
5	28.6	14.3	7.1	5.3	70	35	20	15	35	20	10	10	100	60	30	30	6	8	12	14	1½	1¼	¾	¾
7.5	38.8	19.4	9.7	7.8	80	50	30	20	50	25	15	10	100	60	30	30	4	8	10	12	1½	1¼	1	¾
10	50.2	25.1	12.5	10.8	100	65	35	30	65	30	15	15	100	100	60	30	2	6	8	10	2	1¼	1¼	1
15	73.4	36.7	18.3	15	150	75	45	40	90	45	25	20	200	100	60	60	1	4	8	8	2	1½	1¼	1¼
20	95	47.5	23.7	19.5	190	95	60	50	125	60	30	25	200	100	60	60	0	2	6	8	2	2	1½	1¼
25	118	59	29.5	23.4	200	120	70	60	150	75	40	30	200	200	100	60	00	2	6	6	2½	2	1½	1¼
30	138	69	34.5	27.6	225	140	75	65	160	85	45	35	400	200	100	100	000	1	4	6	2½	2	1½	1½
35	162	81.3	42.5	32	240	160	80	70	200	100	50	40	400	200	100	100	200,000	0	4	6	3	2	1½	1½
40	182	91	45.5	36.4	275	175	90	75	225	115	55	45	400	200	100	100	0000	0	4	6	3	2	1½	1½
50	224	112	56	45	335	200	110	90	280	140	70	55	400	200	200	100	300,000	00	2	4	3	2½	2	1½
60	268	134	67	53.5	400	250	135	110	335	165	85	65	400	200	200	200	450,000	000	1	2	3½	2½	2	2
75	332	166	83	66.5	500	300	165	130	420	210	100	80	600	400	200	200	550,000	0000	0	1	4	3	2	2
100	.....	218	109	87.5	...	350	190	175	...	270	135	110	...	400	200	200	.....	300,000	00	0	..	3	2½	2
150	.....	320	160	128	...	500	250	200	...	400	200	160	...	600	300	200	.....	500,000	200,000	000	..	3½	3	2½
200	.....	418	209	169	...	*700	350	300	...	520	260	210	...	800	400	400	.....	750,000	300,000	0000	..	4	3	3
250	.....	515	257	207	...	*800	400	350	...	*640	320	260	..	800	400	400	.....	1,000,000	400,000	300,000	..	5	3½	3
300	.....	615	307	246	...	*1,000	500	450	...	*765	385	310	...	1,200	600	400	.....	1,300,000	500,000	350,000	..	6	3½	3½

* Where fuses larger than 600 amperes are required circuit breakers of approved type must be substituted.
In a three-wire two-phase system, the two outside wires are the same size as for a four-wire system and the middle wire 1.4 times as large.

that extra money invested in a good, substantial layout, eliminating as many weak links in the system as possible, is money well invested and will pay good returns in the long run.

Another objection to running long feeders and splicing in wherever a motor is to be located is that the motors for different machines will be on one feeder. If anything goes wrong with this feeder it may tie up two or three machines instead of one, as would be the case if the feeders were kept independent of other machines. Each machine should have its own main feeder, with all the motors for the machine tapped off of it. If several important drives are tapped off of one feeder, operators may make the mistake of not having the controller in the off position when starting a large motor, and trip out the circuit breaker on the switchboard, thus causing the shut-down of a number of machines.

Another way commonly used is to run one feeder to several panel boxes. This method also has some disadvantages; among the most important is that anything wrong with one will probably hold up the entire factory. Also, there are so many live parts exposed when the cover is opened that it is dangerous for the maintenance men, and easy to cause a short-circuit or pull the wrong fuse when changing blown ones. About the only advantage to their credit is that they take up small space. The panel box shown was designed for the purpose of overcoming the foregoing disadvantages, and has proved to measure up to all that was expected of it.

(3) The most economical centers of distribution require considerable study, as to how much space is available, will future installation of machines cause a second moving later on, is it cheaper to run the main feeders up close to where the motors are to be set and run short lines, or terminate the main feeder farther away and have longer small lines running to each motor?

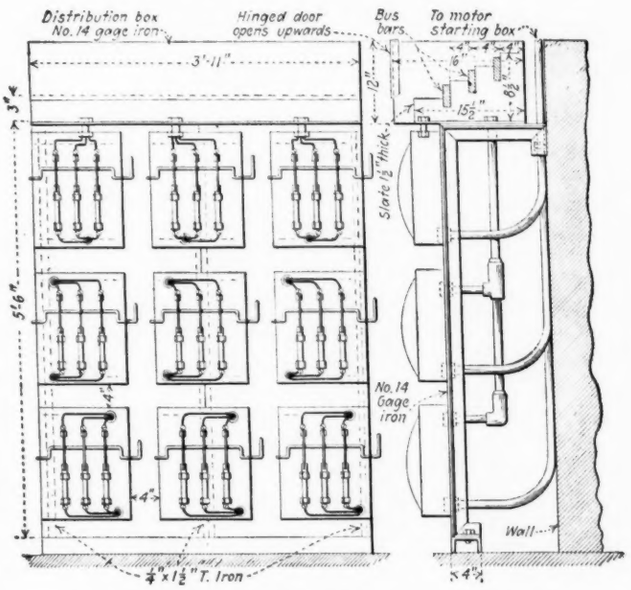
(4) How much over-capacity the main feeders should have will depend on whether there is to be future installation of motors to be taken off of the feeder, or whether motors will be changed to larger sizes later on. When the center of distribution has been selected the size of main feeder can then be decided on.

(5) The number of main feeders to run will depend on the size of the installation and how the machines are to be grouped. If the motors for each machine are to be independent from the rest, one main feeder would be run for each machine. This applies to machines that require several motors. Of course, individual machines with one or two small motors connected with them would have a main feeder taking care of several such machines.

(6) Should the wiring be done in conduit? From the point of reliability, yes, for it makes a good safe layout and when once properly installed it requires little maintenance, and there is small opportunity for shutdowns due to the wiring being damaged.

(7) Location of the equipment so that it will not be in the way of other machinery can be accomplished by co-operating with foremen of the other construction crews. The man in charge of electrical construction should have blueprints of the layout for the piping, machines and sprinkler system.

The panel box shown in the figure is made in two parts, one for mounting the safety switches and the other for enclosing the busbar from which power is



LAYOUT FOR SAFETY-SWITCH PANEL BOARD

distributed from the main feeder to the safety switches. The part of the box on which the safety switches are mounted is made up with a framework of tee and channel iron and covered with No. 14 sheet iron. The dimensions of this panel will depend upon the size and number of switches required. In the figure the dimensions indicated were used for a panel mounting nine 60-amp, 500-volt switches.

First of all, the number and size of the motors that are required to be controlled from the panel box is

TABLE II—WIRING DATA FOR THREE-PHASE SQUIRREL-CAGE MOTORS

	Full-Load, Amperes				Starting Fuse, Amperes				Running Fuse, Amperes				Switch Size, Amperes				Size of Wire				Size of Conduit			
	110	220	440	550	110	220	440	550	110	220	440	550	110	220	440	550	110	220	440	550	110	220	440	550
HP	Volts	Volts	Volts	Volts	Volts	Volts	Volts	Volts	Volts	Volts	Volts	Volts	Volts	Volts	Volts	Volts	Volts	Volts	Volts	Volts	Volts			
0.5	3.6	1.8	0.9	0.7	10	5	5	5	10	5	5	5	30	30	30	30	14	14	14	14	½	½	½	½
1	7	3.5	1.7	1.3	20	10	5	5	10	5	5	5	30	30	30	30	14	14	14	14	½	½	½	½
2	13	6.5	3.2	2.6	30	20	15	10	15	10	5	5	30	30	30	30	10	12	14	14	¾	½	½	½
3	19	9.5	4.7	3.8	50	30	20	10	20	15	5	5	60	30	30	30	8	10	14	14	1	¾	½	½
5	30.8	15.4	7.7	6.2	70	40	25	15	35	20	10	10	100	60	30	30	6	8	12	14	1¼	1	¾	¾
7.5	44.8	22.4	11.2	9	90	60	30	25	55	30	15	10	100	60	30	30	4	6	10	12	1½	1¼	¾	¾
10	58	29	14.5	11.8	120	70	40	30	70	40	20	15	200	100	60	30	2	6	8	10	1½	1½	1	¾
15	85	42.5	21.2	17.4	170	85	50	40	100	50	25	20	200	100	60	60	0	4	8	8	2	1½	1	1
20	110	55	27.5	22.5	180	110	65	55	140	65	35	30	200	200	100	60	00	2	6	6	2	1½	1¼	1¼
25	136	68	34	27	210	140	70	65	170	85	40	35	400	200	100	100	000	1	6	6	2½	2	1¼	1¼
30	160	80	40	32	240	160	80	70	200	100	50	40	400	200	100	100	200,000	0	4	6	2½	2	1¼	1¼
35	188	94	47	37	280	185	95	75	235	120	60	45	400	200	100	100	250,000	0	2	4	2½	2	1½	1¼
40	210	105	52.5	42	320	200	110	85	260	130	65	55	400	200	100	100	300,000	00	2	4	3	2	1½	1½
50	260	130	65	52	400	250	130	110	300	165	80	65	600	300	200	200	350,000	000	1	2	3	2½	2	1½
60	310	155	77.5	62	470	300	160	125	385	190	95	85	600	400	200	200	500,000	200,000	0	2	3½	2½	2	1½
75	384	192	86	77	575	350	175	160	480	240	100	95	600	400	200	200	750,000	300,000	0	0	4	3	2	2
100	.....	252	126	101	...	400	200	175	...	300	150	125	...	400	200	200	.....	400,000	00	0	..	3	2	2
150	.....	368	184	148	...	550	300	250	...	450	230	200	...	600	300	400	.....	550,000	250,000	200,000	..	3½	2½	2½
200	.....	484	242	195	...	*750	400	300	...	*600	300	250	...	800	400	400	.....	900,000	400,000	250,000	..	4	3	2½
250	.....	595	287	240	...	*900	450	400	...	*750	350	300	...	1,200	600	400	.....	1,250,000	450,000	350,000	..	5	3	3
300	.....	710	355	285	...	*1,100	550	500	...	*900	450	350	...	1,200	600	600	.....	1,600,000	650,000	450,000	..	5	3½	3

* Where fuses larger than 600 amperes are required, circuit breakers of approved type must be substituted.

decided upon. Then the switches are selected large enough for their fuses to take care of the starting current of the motors, which may be determined from Tables I and II; these tables will serve also as a guide in selecting the size of the switches. The dimensions are then obtained and the panel box made large enough to take care of them.

Construction of Distribution Box

The distribution box at the top of the panel is made from No. 14-gage sheet iron, and the busbars are mounted in it on slate bases with slots sawed in them to hold the busbars in place. The slate bases are mounted about one foot from each end of the box and held in place by ⅜-in. cap screws and Ackerman-Johnson expansive screw anchors, set in the bottom of the slate. The busbars are long enough to come within 6 in. of each end of the box. The main feeder is run from the switchboard to the distribution box, with lugs soldered on and bolted to the busbars. Short lengths of wire are run from the top of switches to the busbars, with lugs soldered on and attached with brass bolts. By connecting the top of the switches to the busbars, the fuses can be made dead and changed with safety by first pulling the switch.

The distribution box is mounted on top of the switch panel framework, with the front on a line with the front of the switches as shown. Enough space is left between the bottom of the box and the top row of switches to allow the cover on the switches to be opened and closed. For the top row of switches, short nipples are run out of the top of the switch box into the bottom of the distribution box for the wiring. All the conduit for the other switches are run down behind the panel box and into the box at the top of switch, and then from the bottom up behind the distribution box and to the starting box for the motor.

In building up the panel box, it may be made a little larger than is needed at present, if it is thought necessary on account of future installation of motors. Such a panel box has many advantages to its credit. First, it is safe and accessible, and the fuses can be changed and repairs made easily. Second, it provides independent circuits for the motors. Third, there is less danger of short-circuits, since all circuits are separated, and there is no danger of coming in contact with the main busbars when changing fuses or working on switches. Fourth, there are no splices in junction boxes insuring better workmanship and less service interruptions. Fifth, new sections can be added on as desired, or a switch can be easily changed to a different size, in case it is desired to change to a different size of motor.

Motors Should be Tested After Installation

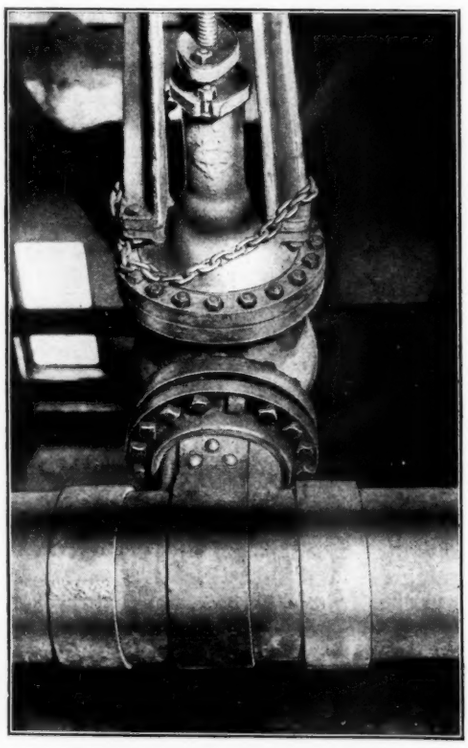
After the installation is completed and in operation, all motors should be tested with a curve-drawing wattmeter, in which case some may be found to be overloaded and some underloaded; changes may be made so as to have each motor carrying about full load, thus improving the power factor and increasing the capacity of the generators by reducing the kilovolt-ampere load on the system. The testing of the motors is done much more quickly and cheaply by having several of the safety switches mounted together, as on the panel box, and not having to move the meter and current and potential transformers to a new location every time a motor is tested. Test sockets can be obtained from the switch manufacturers, with which the meter can be cut into the line feeding the motors without shutting it down. The name of the drive that each switch is on should be stenciled on the cover to prevent mistakes in pulling it.

A Difficult Pipe Job

By R. D. De Wolf*

The Rochester Gas and Electric Corporation recently had occasion to put a welded nozzle in the main steam header in the boiler room in order to take care of some additional steam business contracted for. The 16-in. header was installed in 1913 and it was desired to take a 10-in. line off from this header.

Owing to the vital importance of making an absolutely safe job on this, every precaution was taken to prevent any trouble at a future time with this welded work. As a serious leak at this point would not only close down the customer, with whom continuity of service is absolutely essential, but would also in all probability entirely close down our own plant, we adopted several rather novel safeguards.



COLLARS AND STRAP SECURE WELD.

A section of 10-in. pipe with a Van Stone joint was used for the nozzle. A cast-iron form was made on which to bell out the end of the pipe at the point where it was to be welded into the 16-in. main. After the nozzle was thus prepared, a hole was burned in the 16-in. pipe to fit the nozzle, the edges of the nozzle and of the pipe being carefully beveled. The entire section of the 16-in. header was taken out of the line and the nozzle then welded in, using oxyacetylene

*Chief operating engineer, Rochester Gas and Electric Corporation, Rochester, N. Y.

torches. Great care was used in making the weld, and after the work was finished the section of the header was carefully trued up so that it would fit back into place properly. Doing this work with the section of the header taken out of the line was felt to be quite important, as otherwise there was no means of knowing whether severe strains would be set up due to the contraction and expansion of the header section when being welded.

In order to prevent the possibility of this nozzle blow-off from the header section a heavy strap was bent to shape around the 16-in. header and riveted to the nozzle. The rivets were then welded to insure tightness against leaks. The straps and rivets were designed so that the entire strain could, if necessary, be carried by this strap. This construction is plainly shown in the illustration.

Also, in order to reinforce the header section, a collar was placed around the header each side of the nozzle. This collar was made in halves, carefully fitted to the header, and these halves were then welded together electrically. The collars were designed with sufficient cross-sectional area to carry the entire bursting strain placed on the pipe. It was deemed advisable to use these owing to the fact that this header has been in use for approximately ten years and it was not known to what extent the material might have aged during that time.

Chain-Belt Pivoted Bucket Carrier

In the new pivoted bucket carrier made by the Chain Belt Co., of Milwaukee, a number of refinements give smoother operation and longer life to those parts subject to the greatest wear. Among the more important features are rigid through-rod bucket supports combined with cantilever suspension, easy removal of bucket and chain parts without disturbing the rest of the equipment, and a steel chain constructed with steel side bars, casehardened pins and bushings, and white-iron rolls. The use of steel chain eliminates the defects and mechanical inaccuracies inherent in castings.

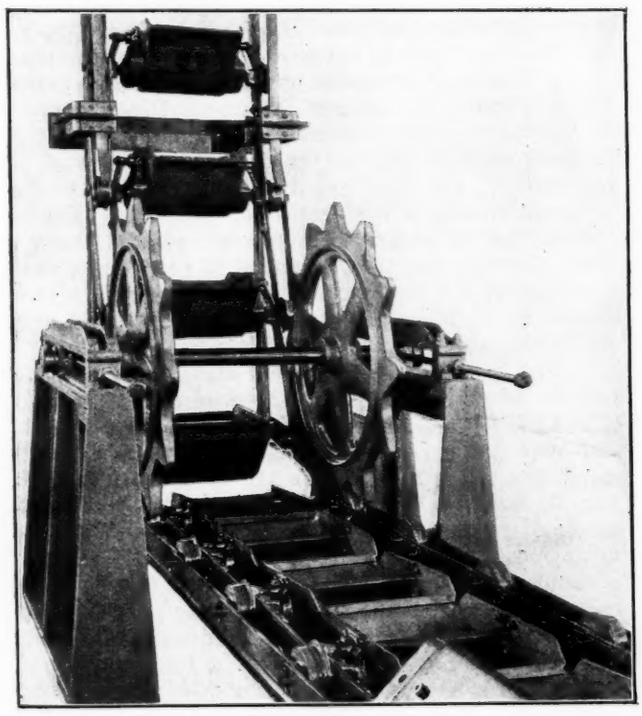


FIG. 1—NEW CHAIN-BELT PIVOTED BUCKET CARRIER

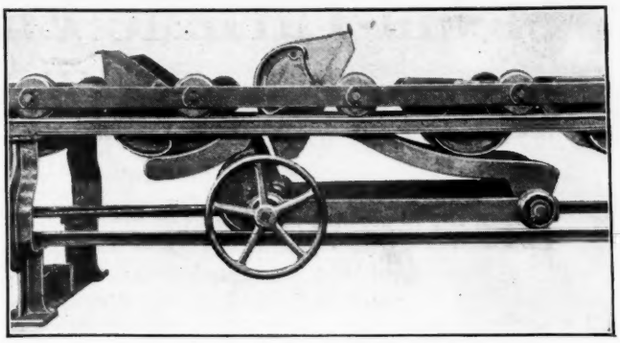


FIG. 2—BUCKET-TRIPPING DEVICE

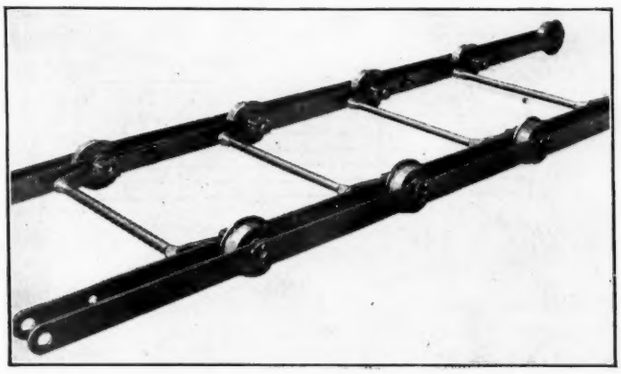


FIG. 3—SHOWING THROUGH-ROD CONSTRUCTION

The general scheme of construction is shown in Fig. 1. Fig 2 shows the method of tripping the buckets. The bucket is held in the discharging position for several seconds, to allow sluggish material ample time to discharge.

Perhaps the most important single feature of the new carrier is the effective combination of rigid through-rod construction with the cantilever principle of bucket suspension, as shown in Fig. 3. Through this combination the load on the chain is concentrated at the center of the chain rollers and the possibility of the chains tilting inward is practically eliminated, resulting in less wear and smoother operation. To assure rigidity, the through-rod is turned down on each end and hot-riveted to the drop-forged steel cantilever side arms.

Although the construction previously outlined eliminates most of the unnatural wear on the chain rollers, normal rubbing wear is minimized by the use of white-iron rollers. This material is so hard that ordinary tool steel will not touch it, special tool steel being required. As pivoted bucket carriers usually transport coarse and more or less abrasive materials, the importance of this wear-resisting roller in terms of longer life is apparent.

The cost of electric power is a very small percentage of the total cost of any manufactured article, and greatest economy is obtained by using electricity for every possible operation. For example, a laborer working eight hours expends total energy equivalent to about three kilowatt-hours. The man's wage is $4 a day, while the energy in the form of electricity could be bought for less than ten cents.

Steam-Turbine Emergency Governors and Trip Valves

By A. D. PALMER

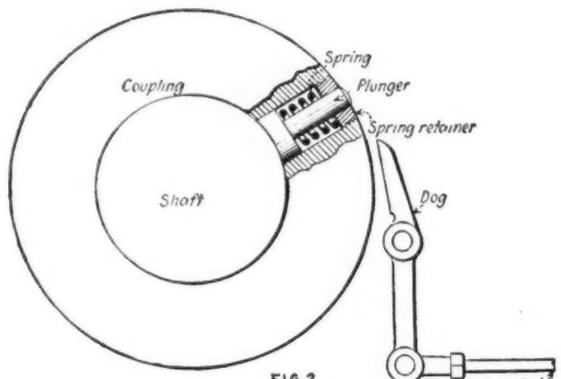
ONE of the important details in the operation and care of a turbine is the matter of the proper adjustment of the overspeed emergency trip gear, the duty of which is to shut off the steam from the machine in the event of its racing or overspeeding. As a general thing turbines rotate at high speeds, and the governors are designed to take care of these high speeds, but in the event of a turbine losing its load, a not infrequent occurrence, it is good engineering

DATE	TIME	R.P.M.	WHY TRIPPED	CONDITION	NOTES	SIGNED

FIG. 1. CHART FOR RECORDING TESTS OF OVERSPEED TRIP

practice to have something that will help the governor to control the turbine. In general these trips are set to operate at about 10 per cent overspeed. This percentage is based and depends upon the size of the turbine and the speed at which it is designed to operate.

There are in operation many turbines that are not provided with a regular attendant whose sole duty is



FIGS. 2 AND 3. COMMON TYPE OF EMERGENCY OVERSPEED TRIP GEAR AND VALVE

the care of the machine, hence it is necessary that the overspeed device should receive more than ordinary care. In some plants the machines are allowed to exceed their regular speed, and trip out just previous to shutting down. This is an excellent method of determining the condition of the trip. A record of the speed at which the machine tripped, and notes relative to the care, adjustments, etc., should be kept, and if a small chart, as shown in Fig. 1, is kept with these data, it will be found to have considerable value.

As a general thing the device that actuates the trip is attached to and forms part of the driving shaft. A

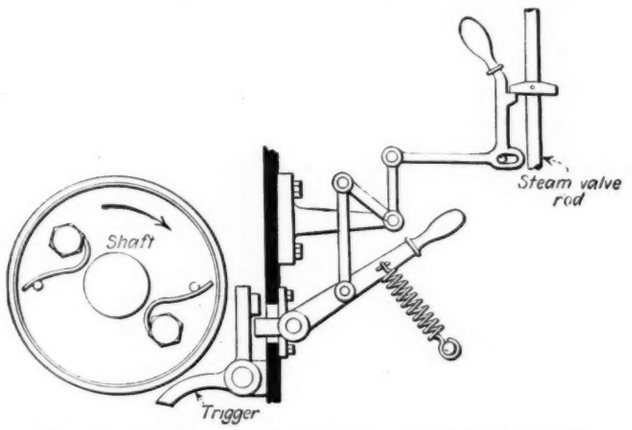


FIG. 4. CLOCK-SPRING TYPE OF OVERSPEED TRIP

common type is shown in Fig. 2. This consists of a small plunger held in a boring in the shaft proper by a coiled spring, and a spring retainer. In action, when the shaft reaches a certain speed the plunger overcomes the tension of the spring and moves out a short distance (usually about $\frac{3}{8}$ in.) and trips the trigger of the limit stop.

With this type of overspeed it is necessary to remove the cap of a bearing when necessary to inspect or adjust the trip. Having removed the cap, turn the shaft until the plunger is pointed upward, then with a screwdriver remove the spring retainer. Directly under the spring retainer will be found a number of thin washers, used to increase or decrease the tension on the spring. In other words, adding to the washer thickness increases the tension on the spring and increases the percentage of overspeed allowed the turbine. Considerable care is needed in getting the exact thickness of the washers for a given speed. In some classes of turbines the washers are dispensed with and the spring retainer acts directly upon the spring.

In Fig. 3 a simple but efficient arrangement of tripping is shown. In this the trip block is connected through a rod and arms to a dog that is acted upon by the shaft plunger, Fig. 2. When, owing to excessive speed, the plunger acts upon the dog, the trip block, Fig. 3, is raised and this allows the spring tension to close the steam valve to the turbine. With this arrangement there is no need of touching the throttle; a handle is provided, so that the latch can be pulled back into place, and the machine is in service again. This will be appreciated on a condenser-pump drive, where maintaining the vacuum is of importance.

In Fig. 4 is shown a type of overspeed device that is used extensively on medium-sized turbines. This con-

sists of two clock springs in tension against stops on the shaft coupling. The tensions of these springs are set so that at about 10 per cent above normal speed the ends move out from the stops and striking the trigger, release the latch lever, which, through a combination of links, releases the steam valve, allowing it to close. While this shuts the steam off the turbine, it does not close the valve control, and before steam can be turned on again, the control must be closed by hand, and the valve opened.

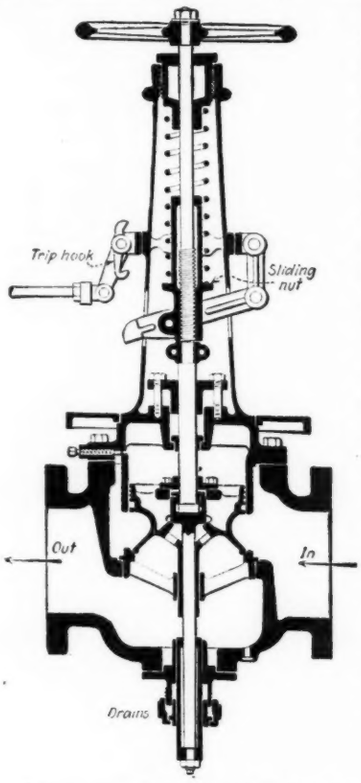
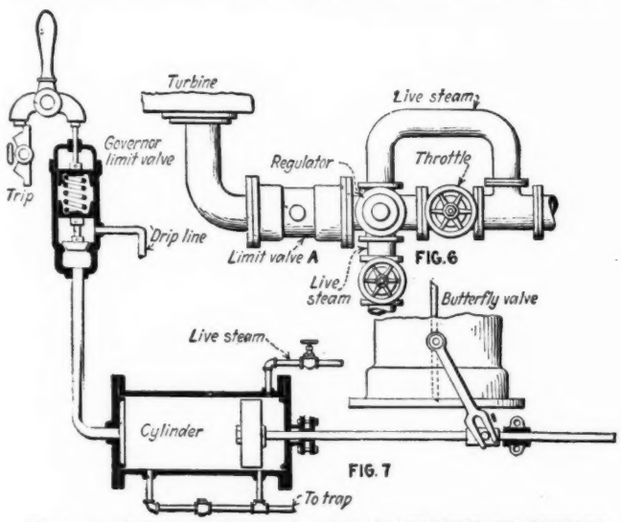


FIG. 5. TYPICAL TYPE OF BALANCED TRIP AND THROTTLE VALVE

A combination trip and throttle valve is shown in Fig. 5. This valve is also built to be used in an inverted position from the one shown. This necessitates some change in design, but the principle of operation is the same.

In low pressure-turbine installations a live-steam as well as an exhaust-steam connection is usually provided, as shown in Fig. 6. The main inlet to the turbine is fitted with a butterfly valve for shutting off the steam if the turbine overspeeds. By referring to Fig. 7, it will be seen that the control for this valve consists



FIGS. 6 AND 7. GENERAL ARRANGEMENT OF STEAM CONNECTION AND EMERGENCY BUTTERFLY-VALVE CONTROL

of a small cylinder containing a loose-fitting piston with a live steam connection to the crank end of the cylinder. From the head end of the cylinder a pipe passes to the automatic limit valve, or the mechanism of the turbine trip. This is simply a small valve held closed by one arm of the governor-valve lever. In operation, when the turbine overspeeds, the safety device on the shaft trips the latch and this allows the limit valve to open and release the steam from the head end of the cylinder. The piston then moves to the other end of the cylinder. This closes the butterfly valve and shuts off the steam to the turbine. Before the butterfly valve can be opened, the hand-controlled throttle valve must be closed to take the incoming steam pressure off the automatic valve.

It will be noticed that drains are provided on the cylinder. It is important that no water be allowed to accumulate in the cylinder, as in the time lost in emptying the water out through the limit valve, the turbine may be lost. An important point with this device is the steam connection to the cylinder. This pipe should be taken directly from the main without any branch lines, and the valves on the line should be locked open. As a general thing a trap is provided on the drain

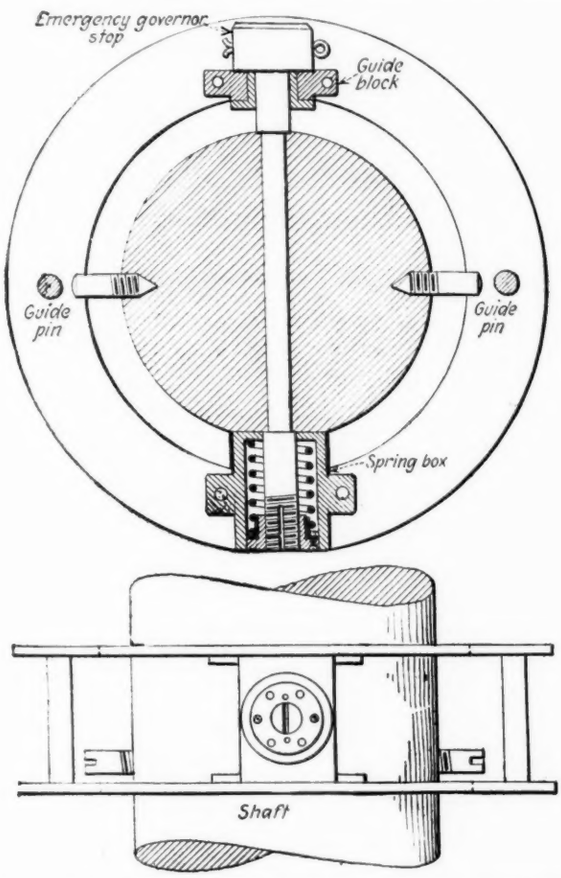


FIG. 8. DOUBLE-RING TYPE OF EMERGENCY GOVERNOR

pipe from the cylinder. When this is done care should be taken to place the trap where it will receive attention and be kept in good operation.

In Fig. 8 a common style of trip is shown, consisting of two rings of steel riveted to a block and spring box. The whole mechanism is supported by a bolt passing through the shaft and held in place against a shoulder by a cottered nut. The spring box contains a spring that is under tension, and the increasing or decreasing of this tension by means of the nut changes the speed at which the trip will function. The guide pins prevent the mechanism from leaving its proper plane of rotation when starting or stopping. It is not necessary to disturb the adjustment of the governor when it is desired

to remove it; if the cotter pin and nut are removed, the bolt can be drawn through the shaft.

Normally, the governor is carried by the shaft in a concentric position, and is therefore slightly unbalanced, the centrifugal force being counteracted by the spring. In operation, as the speed increases above normal, the centrifugal force overcomes the spring and the rings move out to an eccentric position. In this position they strike the trip lever which in turn trips the throttle valve.

It is of vital importance that the attendant in charge of the turbine thoroughly understands the mechanism of the overspeed governor. A daily inspection should be made of the trip valve, and it should be operated at regular periods. Under no condition should a turbine be operated with the overspeed out of order.

The writer recently visited a large plant and found an 1,800-kw. machine running with the emergency governor blocked. The excuse given by the chief engineer was that the spring tension had changed and that he was waiting for a convenient time to adjust it. Unfortunately, I was unable to convince him of his folly.

Throttling in the Steam Valve of a Unaflow Engine and Its Effect on Steam Consumption

By Marshall L. Barker

From time to time the argument has been advanced that throttling of steam in an engine would not impair the steam economy, and this is upheld to a certain extent by some of the principles of thermodynamics, the idea being that the steam is superheated or dried out, as the case may be, and so a smaller amount of initial condensation will occur.

However, it is always difficult to believe that by decreasing the pressure of the steam entering the cylinder the engine will do the same work with the same amount of steam, as this will necessarily require a larger cutoff in order to give the same mean effective pressure.

The accompanying diagrams, taken during two tests, will help to show the fallacy of the argument. They were both taken with the engine in the same working condition mechanically, and the steam conditions were the same to within one or two per cent. The steam

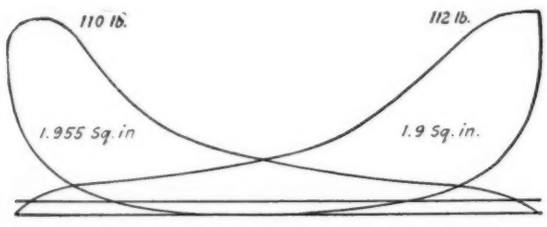


FIG. 1—INDICATOR DIAGRAMS SHOWING THROTTLING

pressure averaged 160 lb. gage with a superheat of 75 deg. The vacuum was 25.6 in. and the load was one-half the engine rating.

The first diagrams, Fig. 1, were taken with the same indicator and spring as Fig. 2, but a few weeks earlier. The engine was fitted with a slower cam than when diagrams in Fig. 2 were taken and this gave a smaller lift to the double seated poppet valves. Fig. 1 shows throttling of the steam because of the higher velocity. The drop was from 160 to 112 lb. and 110 lb. on the two diagrams. The diagrams in Fig. 2 were taken with a faster or steeper cam, giving a greater valve lift and consequently a lower steam velocity.

An hour's test with the engine giving the diagrams in Fig. 1 required a steam consumption of 15.3 lb. per i.hp.-hr. as against 13.3 lb. for the test when the diagrams in Fig. 2 were taken. There is only 5 lb. throttling from boiler pressure on one end and 12 lb.

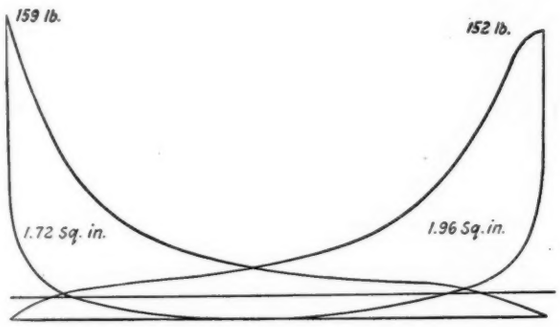


FIG. 2—DIAGRAMS WITH NO THROTTLING

on the other end of the diagrams, Fig. 2, which is as good as could be expected on a high-speed poppet-valve engine at such light load and small cutoff. Similar tests were run at three-fourths load, with similar results, but lower respective steam consumptions.

A Few Refrigerating Notes

Overhauling of refrigerating equipment should be done at reasonable intervals, say once a year, and consists in cleaning the ammonia charge, cleaning the brine, cleaning all parts constituting the plant, repairing defects in apparatus and machinery, testing all parts of the plant and recharging and getting ready for new work.

Any ammonia charge may be contaminated by dirt left in the system before charging or by contact with packing materials, gaskets and lubricants during operation. Gasoline and kerosene used for cleaning, soap or lard oil used for cutting threads on pipes, grease, wax or asphalt contained in packing and gaskets are among the materials that may impair the ammonia. Most frequently, however, a bad quality of compressor oil is responsible for deterioration of the ammonia charge. Liquid anhydrous ammonia is to some extent a solvent for many of these materials, some of which can be eliminated by redistilling the ammonia.

When the temperature of a cooler or freezer is only about eight or ten degrees above the boiling temperature of the liquid ammonia on the inside of the expansion or evaporating coils, the engineer can expect nothing except a slow or "sluggish" evaporation. Do not swear at the man who sold you the ammonia for selling you an inferior quality or a kind that will not mix with what you already had, etc., but look for the cause. If the temperature is not holding or coming down as it should, it is generally due to slow evaporation, as already explained, a shortage of ammonia in the system, not enough pipe surface in the cooler for the product to be handled, or one or more of many other causes. It is necessary to have a temperature difference of 10 to 15 degrees between the ammonia and the cooler to insure rapid boiling.

The Efficiency of Unaflow Engines

Points of Engine Design That Determine the Results To Be Obtained from Unaflow Steam Engines

By A. D. SKINNER*

THE excellent article on the unaflow engine industry in the United States appearing in *Power*, June 20, contains one statement that I have every reason to believe is not correct, and inasmuch as this article contains the first comprehensive and authentic data concerning the rapid advance of the unaflow engine industry in this country, it probably will be used for some time as a text by those who wish to obtain information as to the latest development in steam prime movers. For this reason I believe this statement, which reads as follows, should be corrected:

> As a consequence, the steam consumption of the many makes of engines is almost identical, the choice between the engines being in the main dependent on a preference for some constructive detail found in a particular design.

The reader of this article might assume from the statement quoted that as long as an engine had central exhaust ports, a long piston and steam-heated heads, it being a unaflow engine, would give just as good economy as any other unaflow engine irrespective of any other difference in details of design.

Variation in Economy

It may seem like a startling statement, but it is true that unaflow engines differ more greatly in their respective economy than counterflow engines. The reason is that a properly designed unaflow engine under certain conditions can give the lowest steam rate of any steam prime mover, and an improperly designed unaflow engine can have as poor a steam rate as many types of counterflow engines after they have been in service many years.

Miracles should not be expected from any engine having a steam-heated head, a long piston and central exhaust ports, if the rest of the design is not conducive to highest economy. It is an actual fact that in several instances unaflow engines placed alongside of Corliss engines that were from ten to fifteen years old showed so much greater a steam rate that the unaflows were removed. It is also equally true that these unaflow engines had long pistons, central exhaust ports and steam-heated heads. There are actually more elements that enter into the design of a high-economy unaflow engine than obtain in the design of a counterflow engine.

Any unaflow engine must have steamtight poppet valves. If they are poppet valves, these valves must be steamtight under variable steam pressure and temperature conditions, which is impossible with some designs of poppet valves. Any poppet valve can be ground tight to one temperature condition which corresponds to a certain steam pressure, but if the steam pressure varies, as it does in practically every plant, the temperature will vary, and unless the valve is specially designed to compensate for such variation, it will leak.

A leaky valve on a unaflow engine would cause more disappointment than on a counterflow engine because of the greater difference between the actual and the expected steam rate. As an example, an owner of two unaflow engines of different makes, operating condensing, each engine having double-beat poppet valves, found a noticeable difference in the steam rate of the two engines, and after making an investigation to determine what caused this difference, he discovered that the valves on one engine were perfectly tight and the other valves were very leaky. The perfectly tight valves had been specially designed so that they would not leak at any steam pressure or temperature; the others were the typical double-beat type.

Auxiliary Exhaust Valves

That European unaflow-engine builders discovered this defect of the ordinarily constructed poppet valve is evidenced by a letter written by Gebrüder Sulzer, Winterthur, Switzerland, in 1913, which reads as follows:

> . . . When we made our exhaustive tests we often found steam consumption figures which contradicted one another very much. We then detected that this was due to the fact that the valves were sometimes perfectly tight and at other times very leaky, owing to the various temperatures to which they were subjected, and to the impossibility of properly grinding them tight for variable temperatures. . . .

If the engine is to operate non-condensing, there is a difference in economy and flexibility under normal conditions of operation if the engine has auxiliary exhaust valves and operates with small clearance or if it has no auxiliary exhaust valves and operates with large clearance. Likewise there is a difference in the economy due to the location of the auxiliary exhaust valves.

For instance, if steam at 150 lb. pressure be supplied to the throttle and the wiredrawing through the valve is such as to obtain only 125 lb. pressure in the cylinder, economies corresponding to an initial pressure of 125 lb. would obtain instead of those of 150 pounds.

Hot Cylinder Heads

Steam-heated heads are placed on unaflow engines to increase the economy. The increase in economy on properly designed unaflow engines due to the effect of the steam-heated heads is greater than on counterflow engines. In addition a condensing unaflow engine that has a clearance pocket in the steam-heated head to allow it to operate non-condensing, or a non-condensing unaflow engine that has a clearance pocket in the steam-heated head to allow it to operate non-condensing with higher back pressures than usual, will not be as economical as a unaflow engine whose entire cylinder head is steam-heated. This is because the clearance pocket located in the steam-heated head removes just that much of the steam-heated head effect.

Under certain conditions a unaflow engine with partial cylinder steam jackets is more economical than a unaflow engine of identically the same design throughout but not having partial cylinder steam jackets.

The matter of steam leakage through the admission valves has been discussed, but leakage through the exhaust valves on a non-condensing unaflow engine should also be given consideration. I am convinced that

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no solid double-beat poppet exhaust valve can be as tight as a single-beat exhaust valve, for the reason that the interior of the exhaust valve is alternately heated by the live boiler steam and the next instant it is cooled both inside and outside by the washing action of the rush of exhaust steam as it flows through the valve.

Unaflow engines of the larger sizes are more economical when they are so designed that the admission valve gear automatically compensates for the longitudinal cylinder expansion and contraction at various loads which is noticeable on all large unaflow engines. The admission gear is of course not influenced by the changes of temperature in the cylinder, and any gear that does not compensate for this longitudinal cylinder expansion and contraction will function so as to develop a greater horsepower on one side of the piston than the other except at one certain load. An engine developing a much greater horsepower on one side of the piston than on the other of course is not as economical as one that has an evenly divided load, nor does it regulate as closely.

Leaky Steam Valves

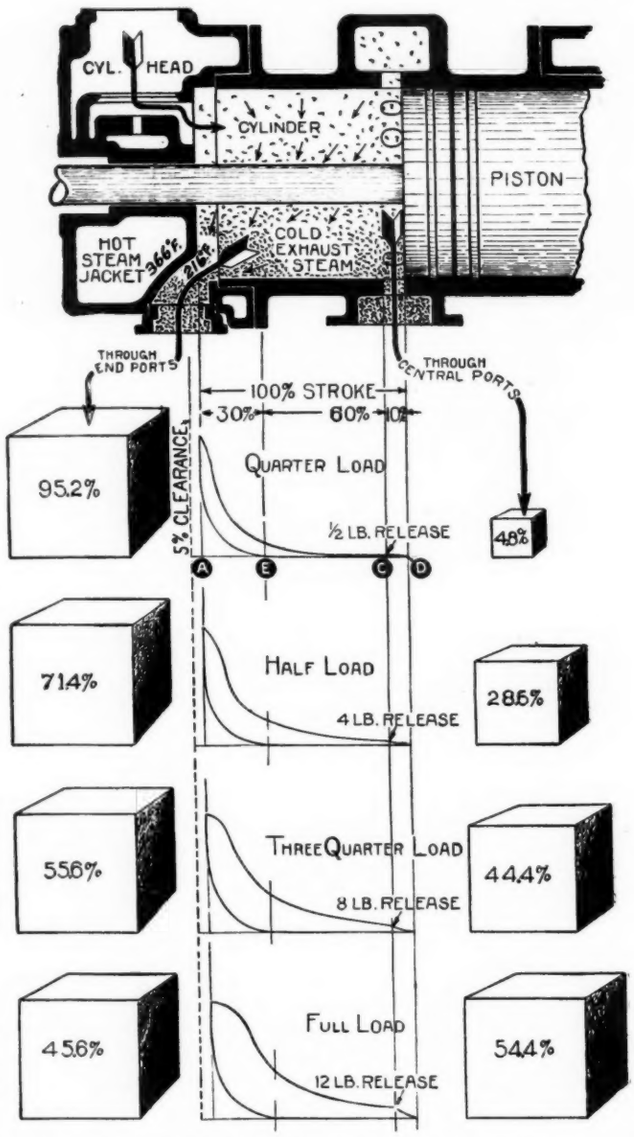
With regard to the maintenance of economy a poppet valve will, of course, afford the nearest approach to the original economy being maintained for a long period of time, assuming that other parts of the engine do not wear so as to leak steam. Take two unaflow engines of identically the same design in every particular with the single exception that one is built so that the rush of steam to the cylinder through the inlet valve is in one direction only and the other is built so that the flow of steam to the cylinder through the inlet valve issues on diametrically opposite sides of the valve, and the latter design of engine will show the better maintained economy.

The former design allows side thrust to be exerted against the valve when opening to admit the steam to the cylinder. This side thrust is caused by the unequal impulse of steam pressure around a double-beat poppet valve. Where there is only one port entering the cylinder from the valve chest, there is a maximum of side thrust, which wears the valve guide below the valve and the valve-stem guide above. When this wear takes place, as it will, the valve becomes quite leaky. This is due to the fact that side wear occasioned by side thrust allows the valve to seat in a different place on the cylinder seat than that to which it was originally ground. It should be remembered that the seats of any double-beat poppet valve are only annular rings about ¼ in. in width, and only as long as these annular rings register at the time of closing with the surface of the cylinder seat to which they are ground, can the valve be tight, provided, of course, that the design of the valve in other ways is such as to compensate for any difference in expansion and contraction of the cylinder seats.

The item of possible leakage past the piston has been neglected in the foregoing analysis, it being assumed that all unaflow engines would have equally tight pistons. The maintenance of steamtightness of a unaflow piston is a much more difficult problem to analyze and solve than with a counterflow engine, because a unaflow cylinder, which has the same diameter throughout its length when cold, has a smaller diameter at the central exhaust ports than at the end of the cylinder when it is in operation. In the proper machining of the cylinder lies the solution of whether the piston rings will allow steamtightness for the same length of time that they would in a properly designed counterflow engine. With a unaflow cylinder properly designed, steamtightness equal to that of a counterflow may be realized.

The truth of the foregoing statements has been repeatedly proved by comparative tests on unaflow engines in actual service. I could cite many tests, but the following is representative:

A user of many engines had two unaflow engines of different makes but of the same cylinder dimensions and rated horsepower. The engines were tested at full load, which was the same on both tests, there being only 0.7 of a horsepower difference. The tests were made by the same engineers and all conditions were made as nearly the same as possible, the only difference being that one engine had a steam pressure of 132 lb. and the other 139. Notwithstanding this, one engine used 28.3 per cent more steam than the other, which is not accounted for by the slightly higher steam pressure with which the more economical engine was favored.



PERCENTAGES OF EXHAUST LEAVING BY THE CENTER PORTS AND BY THE AUXILIARY EXHAUST VALVE

I trust that the foregoing has proved my case; namely, that all unaflow engines having central exhaust ports, long pistons and steam-heated heads will not have equal economy or even approximately equal economy, and that the highest economy can be reached only by the unaflow engine incorporating the greatest number of steam- and heat-conserving elements.

The unaflow-engine design in itself tends to conserve the heat in the steam by minimizing cylinder condensation, which is ex tent to a great degree in counterflow engines. On non-condensing unaflow engines it has been found advisable by many builders to incorporate exhaust valves to supplement the central exhaust. These valves delay the beginning of compression and allow the engine to operate with smaller clearances and to give a higher mean effective pressure for the same point of cutoff. A non-condensing unaflow engine, therefore, equipped with auxi'iary exhaust valves is more flexible than one without; and, if the exhaust valves are properly located, I maintain that the engine is more economical.

The location of the auxiliary exhaust valves is of secondary importance only to the type of steam valve and exhaust valve used, and the location of the exhaust valves can affect the economy of a unaflow engine to a greater extent than any other factor save valve leakage.

Steam Flow Through the Valves

The illustration shows a unaflow engine with what is popularly known as the auxiliary exhaust port placed at the end of the cylinder. This auxiliary exhaust port is a misnomer because it exhausts a greater weight and volume of steam than the central exhaust port; and it was with the realization of this fact that one of the early patentees of a unaflow engine with supplementary exhaust valve called the supplementary exhaust ports the main ports.

The release pressures shown were obtained from actual indicator diagrams, and there is therefore absolutely no guesswork as to the accuracy of the following figures.

At the instant when the piston uncovers the central exhaust ports, or at point *C* on the indicator diagram, the steam in the cylinder is about to be exhausted at the respective pressures shown on the indicator cards and the weights of the steam per cubic foot at this pressure, which were obtained from standard steam tables, are indicated in column 1 of the table.

The piston then proceeds to the end of the stroke, the steam exhausting through the central exhaust ports. When the piston has reversed its motion and covered the central exhaust ports on the return stroke, the remaining steam is trapped in the cylinder at the same pressure as in the exhaust pipe, which in this example has been taken at atmospheric pressure. The weight of steam per cubic foot at this pressure is shown in column 2. These figures have been taken from standard steam tables.

The difference, then, between the weight of the steam in the cylinder at the pressure of release and the weight of steam at atmospheric exhaust after the steam has been exhausted from the cylinder is the difference between columns 1 and 2, which difference is shown in column 3, and which represents the weight of steam discharged through the central exhaust ports.

Of the steam remaining in the cylinder when the piston has just closed the central exhaust ports, which remaining steam includes 90 per cent of the piston displacement plus 5 per cent clearance, 63⅓ per cent is pushed out of the end ports by the piston. The other 36⅔ per cent of the steam is trapped in the cylinder by the closing of the end exhaust valve and is used for compression. Column 4 shows the weights discharged from the end exhaust ports, which are 63⅓ per cent of the steam remaining in the cylinder, as given in column 2.

The total weight of the steam exhaust is therefore the sum of the weights of the steam exhausted from the end ports and the central ports, or the sum of the weights in columns 3 and 4, which is shown in column 5.

Column 6 shows the percentage of steam exhausted through the central exhaust ports, which is the proportion of column 3 divided by column 5.

Column 7 is the percentage of steam exhausted through the end ports and is the proportion of column 4 divided by column 5.

These calculations for the sake of simplicity are based on the cylinder having a volume of one cubic foot at the time the piston starts to uncover the central exhaust port, which volume includes 5 per cent clearance.

STEAM THROUGH CENTRAL AND END EXHAUSTS

Load	Release Press	Lb. per Cu.Ft. at Release	Lb. per Cu.Ft. at Atmosphere	Central Ports Discharge Col. 1 — 2	Aux. Ports Discharge, 63⅓ Per Cent of Col. 2	Total Exhaust Col. 3 + 4	Per Cent Through Central Ports	Per Cent Through Aux. Ports
	0.5	0.0385	0.0373	0.0012	0.0236	0.0248	4.8	95.2
	4.0	0.0468	0.0373	0.0095	0.0 36	0.0331	28.6	71.4
	8.0	0.0561	0.0373	0.0188	0.0236	0.0424	44.4	55.6
Full	12.0	0.0654	0.0373	0.0281	0.0236	0.0517	54.4	45.6
Average...							33.05	66.95

It will be seen that the average weight of steam exhausted through the central exhaust ports for the four different loads is 33 per cent and 67 per cent through the end ports. Such a design, I maintain, is 67 per cent counterflow.

It will be noted that cold exhaust steam of approximately 216 deg. F. flows past the hot steam jacket containing steam at 365 deg. temperature, if the steam pressure is 150 lb. gage. Not only this, but it flows past the hot cylinder walls which, the instant before cutoff took place, had been subjected to the same temperature. It would therefore be preferable to locate the so-called auxiliary exhaust port a sufficient distance away from the steam-heated head to prevent the exhaust steam from absorbing heat from the head and that section of the cylinder wall which had been heated by the boiler steam before cutoff took place. This would prevent the condensing of steam in the steam-heated head, which is loss of economy, and prevent the cooling of the hotter cylinder walls and heads, which cooling would increase the cylinder condensation, to eliminate which the unaflow design was adopted.

Supplementary exhaust valves can be placed in the cylinder at the same distance at which it is usual to start compression in any Corliss or four-valve counterflow engine without this cold steam flowing past the highly heated heads and the hotter cylinder walls. Locating these ports 25 or 30 per cent away from the end of the cylinder would accomplish this result, and the hotter cylinder walls would not be subjected to this colder steam because with a unaflow engine high economy is accompanied by early cutoffs and cutoffs such as 20 or 25 per cent would occur only on overloads.

New Angle-Compound Steam-Driven Air Compressor

To its line of angle-compound air compressors the Sullivan Machinery Co., of Chicago, has added a steam-driven unit, with a single, highly economical steam cylinder placed in the rear of and tandem with the low-pressure air cylinder. As shown in Fig. 1, the air compressor itself is of the inclosed type and practically identical with former designs.

The feature of the new unit is the steam cylinder used. This is of the high-duty, direct-flow, four-valve

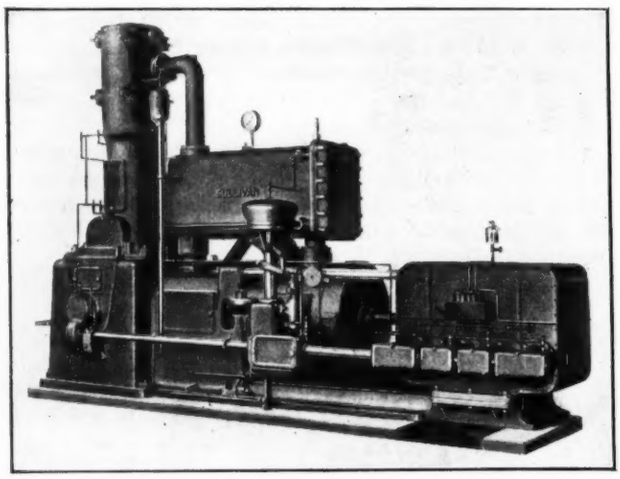


FIG. 1—ANGLE-COMPOUND AIR COMPRESSOR

type in which the steam travels in a direct path from admission valves at the cylinder ends to exhaust valves near the center of the cylinder. All four valves lie side by side in the same plane, as shown in Fig. 2, and are operated by individual cams mounted on a single-motion shaft running the length of the compressor and deriving its motion from the crankshaft through spiral gears.

Poppet Valves of Wafer Type

Both admission and exhaust valves are of the wafer type, following closely the design used in the air cylinders, except that they are mechanically instead of automatically operated. They consist of flat rings of thin, tempered alloy steel. Each of the steam valves is supported by a four-arm spider and a removable seat. The seat is pressed into the cylinder head, and the valve is held against it by a coiled spring on the outboard end of the valve stem. It will be evident that although steam entering the cylinder head will hold the valve tight on its seat, at the time of actual operation the valves are practically balanced, since at admission the compression has built up to initial pressure and at exhaust there is little difference between pressures within and exterior to the cylinder. Thus the power to operate the valves is minimized. To obviate the use of a separate relief valve, a coiled spring is placed behind each steam admission valve to give relief at the end of the stroke when the valve stem is at rest. This relief allows for any variation in the ratio of compression with changes in steam pressure and does away with a separate valve for this purpose.

With the exception that the relief springs are omitted, the two exhaust valves are similar to the admission valves. The exhaust cage has a ground shoulder fitting a similar shoulder in the cylinder; it is pressed into the cylinder and is held in place by a nut adjustment on the exhaust bonnet.

The cams operating the steam valves are not fast to the camshaft, but move in unison longitudinally along the shaft under the action of the governor, and as they are tapering, the points of cutoff at both ends of the cylinder are varied simultaneously to meet changing conditions. This movement is effected by a rod passing from a bell crank at the foot of the governor stand through the hollow camshaft to the cams. However, changing the point of cutoff does not affect the point of admission, which is always timed exactly for all varying load and speed conditions.

The exhaust-valve cams, on the other hand, are manually set for any exhaust condition to give the right amount of compression. As they are mechanically operated, the point of exhaust may be timed almost exactly at the end of the stroke, so that the full benefit of expansion may be had.

Method of Governing

Control is through a combination speed and pressure governor consisting of two elements, a ball governor to maintain a uniform maximum speed of the compressor and a pressure cylinder, in communication with the air receiver, which automatically changes the position of the governor and therefore the point of cutoff in the steam cylinder, to maintain the desired air pressure.

The steam cylinder is secured to a bedplate bolted to the foot of the main or horizontal frame of the com-

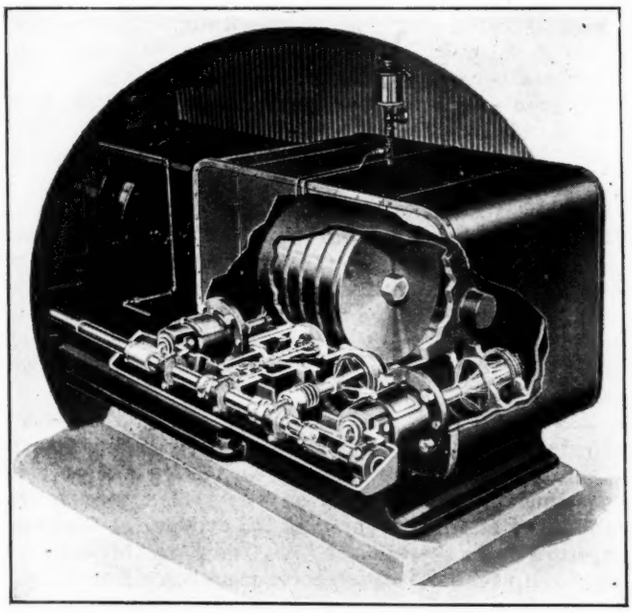


FIG. 2—DETAILED SECTIONAL VIEW OF STEAM CYLINDER

pressor, and at the top two tierods assist in maintaining alignment.

At present the new compound compressor is being built in single units in two sizes, to give respectively 1,200 and 1,800 cu.ft. displacement per minute. To handle large volumes of low-pressure air, a low-pressure cylinder is placed on the high-pressure frame and the two cylinders operated "in parallel."

EDITORIALS

Pulverized Coal

POWER PLANT engineers have been devoting considerable study to the economic possibilities of pulverized coal. The recent announcement that the new power station at St. Louis will use this fuel has increased this interest.

What ideal requirements may pulverized-coal plants be expected to meet? This question cannot be answered positively for the art is still young. However, experience is accumulating, and it is now possible to suggest some lines along which progress may be expected. These suggestions may stimulate thought on certain aspects of the problem and speed up development.

The problems involved in a pulverized-coal plant are those connected with pulverizing, coal handling, furnace construction, ash disposal and furnace control. The pulverized-coal plant should not exceed in size the stoker-fired plant and will ultimately probably be much smaller. This will require compact drying and pulverizing equipment. Waste gases from the breeching are adequate for drying coal and should be used in every case, thereby saving coal otherwise burned under dryers. Besides, furnace efficiency is improved by the removal of moisture from the coal, and this alone in the average case justifies drying.

There is room for simplifying pulverizing equipment. The ideal system would seem to be a simple pulverizer unit combined with a dryer and feeder system in such a manner that the coal flows automatically from the raw coal bunker through the dryer, pulverizer and feeder fan into the burner. This should be arranged so that it is under the direct control of the fireman.

Large furnaces are essential for high efficiency and for high ratings. The use of hollow air-cooled walls, water screens and radiant-energy superheaters make the problem of furnace design relatively simple.

Water screens have practically solved the difficulty of the fusing of ash, and there will undoubtedly be further development in means of catching the finely divided ash contained in the chimney gases. Methods are also under way for utilizing more of the heat in the waste gases.

The problem of boiler control with pulverized coal is essentially that of maintaining the desirable ratio of coal to air at all loads. As powdered coal burns very much like oil, less excess air can be used than with stokers. The difficulty in control arises from the fact that with increasing load the change in air supply must precede the change in coal supply and with decreasing loads the reverse must hold. This is apparent when one considers that the ratio of coal to air always approaches the ideal mixture, that excess coal over air with increasing load causes a decrease in furnace temperature and, if the regulator responds to steam-pressure control, that a still greater amount of coal is then fed, which further aggravates the trouble.

When development has been made along the lines suggested, the advantages of pulverized coal will be still more marked.

Electric Fire Hazards

IT MUST be acknowledged that the presence of electric light and power circuits in any place may create a hazard to life and property if proper precautions are not taken. What can be said of the electric circuit is true of any system for furnishing light and power. A steam boiler, if neglected, creates an extremely dangerous hazard to both life and property, as is attested by thousands of regrettable examples. By proper construction, inspection, maintenance and operation the steam boiler has been made as safe as any piece of power-plant equipment. It is only when this equipment is neglected, or handled by those who are incompetent, that a high-pressure boiler becomes a serious hazard.

In the plant where power is transmitted mechanically, with its multiplicity of belts and shafting, even when these are maintained in good condition, the fire hazard is much higher than when the power is transmitted electrically and this mechanical power-transmitting equipment has been eliminated to a large degree. When the electrical equipment is properly installed, it is easily maintained in good condition, whereas the mechanical means of transmitting power requires a large amount of attention to keep it in good condition. What is true of power transmission, is true of lighting. In fact, where lighting circuits are properly installed, the fire dangers attendant to the use of the old candle, oil lamp or gas has been practically eliminated. Notwithstanding this, there has been a general impression that the presence of electricity created a fire hazard that did not exist before its introduction.

To combat this erroneous idea the Society for Electrical Development in its 1922 report has carefully analyzed the prevalence of fires of electrical origin in residence and commercial buildings in three hundred and fourteen communities having a total population of twenty-five million. In these three hundred and fourteen communities only one fire in every forty-one from all causes could probably be attributed to the presence of electric circuits. In forty per cent of the communities for every ninety-two fires from all causes only one could be traced to electrical origin and in thirty per cent of the communities only one fire was traceable to the presence of electric circuits for every one hundred and fifty from other causes.

As to the fire loss this investigation shows that in two hundred and sixty-three communities, which included some of the largest cities in the country, if the fires attributed to electric circuits could be eliminated entirely, it would reduce the total loss only about three and one-quarter per cent. In over fifty per cent of the communities this loss amounted to less than one-half of one per cent of the total.

These figures, it must be admitted, are not of such value that would cause alarm to the most conservative. They conclusively show that, even with our present methods of installing and maintaining electrical circuits, the fire loss from this source is very low compared to the total from all causes.

The Obsolescent Boiler Horsepower

MUCH of engineering has, like "Topsy," "just growed." Some things that we do are not worth doing, yet custom gives them an appearance of utility.

A vivid example is boiler horsepower, or rather the boiler horsepowers—for horsepower has two distinct meanings when applied to boilers. When a boiler evaporates the equivalent of 34½ pounds of steam per hour "from and at 212" we say it is developing one boiler horsepower. Why 34½? Because years ago the average engine used about thirty pounds of steam per hour for each indicated horsepower and thirty pounds actual evaporation was, for average boiler conditions, about equivalent to 34½ pounds "from and at 212."

As far as any definite relation to horsepower is concerned, the developed boiler horsepower has become practically meaningless. It is merely a roundabout way of stating how much heat is being usefully employed by the boiler. To evaporate one pound of water "from and at 212" requires 970.4 British thermal units, so that 34½ pounds will require 33,479 B.t.u. per hour. Instead of using an odd figure like this to get another equally meaningless, why not state directly how many B.t.u. the boiler is transmitting each hour, or at the most limit ourselves to three ways of stating boiler output, namely: Pounds of steam per hour under actual conditions, pounds per hour "from and at 212" and B.t.u. per hour. Have we not told the whole story about output when we say that the boiler evaporates so much steam per hour under such and such conditions, and that this is equivalent to so many B.t.u. and so much evaporation "from and at 212"?

On the other side of the fence we have the rated boiler horsepower, which has no fixed relation to what a boiler can do. With the general agreement on ten square feet of surface to the rated boiler horsepower, the latter becomes nothing but a new and useless unit of area. If 150 rated horsepower always means 1,500 square feet, why not call it 1,500 square feet and be done with it? Why divide even by such a simple number as ten?

Cannot a maker tell the whole story by saying, "Here is my boiler; it costs so much, it has so many square feet of heating surface; under such and such conditions I guarantee that it will evaporate so many pounds of water per hour, which is equivalent to so many B.t.u. per hour"?

Engineers could wipe out the boiler horsepower with no more pain or loss than their grandfathers experienced on shaving off their "sideburns" when these ornaments ceased to meet with universal approval.

The Absorption Refrigeration System

EXAMINATION of the Bureau of Census reports indicates that the absorption system of refrigeration is not maintaining its relative position in the ice-manufacturing field. The Census reports cover only plants manufacturing ice and do not include cold storage or industrial plants. It appears that there were almost twenty-five hundred ice plants using the compression system and but three hundred and fifty-one absorption plants in 1919, a decrease in absorption plants of sixty-six since 1914.

At first glance it would seem that the absorption plant is being supplanted. However, the absorption system is not as suitable for ice making as for other types of refrigerating plants. In the ice plant it is seldom that exhaust steam is available for the absorption system, and if live steam must be used, the absorption system loses the advantage it possesses when waste steam is available.

In industrial plants where large quantities of exhaust steam are thrown away or where low temperatures are required, the absorption system is the superior, and it is unfortunate that it does not receive the attention it merits. It would seem that it would be of particular advantage in plants where steam turbines are used. By bleeding between stages, steam at twenty-five pounds or so could be supplied to the absorption generator. In this way that part of the turbine load carried by the bleeder steam would be obtained at almost one hundred per cent efficiency.

An arrangement whereby power generation and steam heat could be carried on in the winter season, the heating system being replaced by the absorption ice plant in summer, would offer the maximum efficiency possible to obtain in any power plant, being close to seventy per cent instead of the usual seven to ten per cent of the condensing steam plant. Combined power and steam-heating systems have often failed, because of the low efficiency during the non-heating season, but the absorption refrigerating system would, apparently, serve to reduce power cost to the minimum.

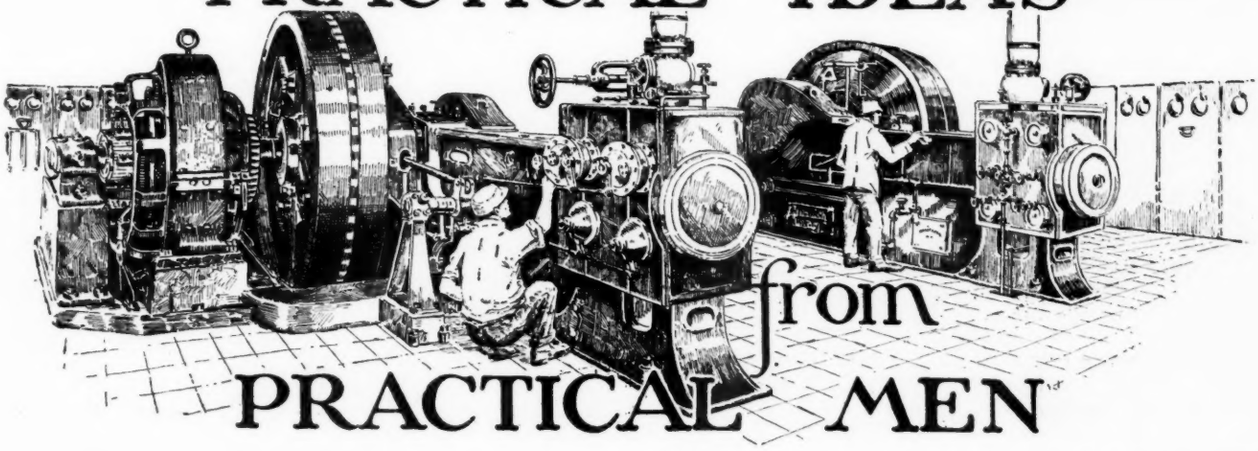
Let's Have a Commission of Engineers

IT IS reported that the Administration at Washington plans to have the commission to inquire into the coal industry composed of representatives of the public. This is a step in the right direction, as it is of no advantage to have either party to an industrial dispute sit as members of the investigation body. On the other hand, if the personnel of this commission is similar to that of the usual governmental investigating bodies, there is grave danger that the results will consist merely of a bulky report containing no intelligent interpretation of the ways and means of untangling the mining snarl.

It is of the greatest importance that this fact-finding commission contain at least one engineer, who is not prejudiced in his views by reason of his business associations. In fact, if President Harding should appoint engineers only on the investigation body, the country could have a greater degree of confidence in the resulting report. It is absolutely necessary that at least one member have the engineering background in the absence of which it is hopeless to attempt to dig out industrial facts. The average professional engineer is neither an employee nor a workman. However, in view of his relationship to both sides of industry, he can appreciate the viewpoint of each.

It is to be hoped that the coal owners will not oppose the work of the commission as was done by injunction in the Maynard case. The public is quite willing that the operators shall make a fair profit and that the miners shall earn enough to meet the American standard of living. If, however, by reason of wasteful methods of mining, multiplicity of hands through which the coal must pass before reaching the public, excessive royalties and unreasonable value placed on the coal lands, the final price of coal is exorbitant, the public is entitled to know the facts and to insist that these conditions be remedied. Let us have a commission of engineers.

PRACTICAL IDEAS from PRACTICAL MEN



Removing Broken Stud Bolts

There are several ways of removing broken stud bolts, but the method I generally use and one that I think entails a minimum amount of labor and gives results, is as follows: Take an electric drill and drill into the broken stud a hole ¼ to ½ inch in diameter, depending on the size of the stud that is to be removed. Drive an "easy out" a little larger than the hole that was drilled into the stud, then take a wrench and turn the stud out. If it appears rusted, put on a small quantity of turpentine or kerosene and this will assist in loosening the stud.

An "easy out" is similar to a drill, only having a left-hand screw, and it cuts into the stud. They can be obtained in five different sizes at almost any hardware store, and the cost is small in comparison with the time usually spent in removing broken studs.

Minneapolis, Minn. H. J. SCANNELL.

System in Hiring Help

In these days, when system is a big word in many central stations and industrial plants, one should not be surprised at anything one meets with in the system line. The other day, however, I ran up against something that was new to me.

I had received a letter from the superintendent of a large power station, relative to my application for employment. I called at his office, and we went through the usual routine of discussing what I had done in the past, what my experience was with the type of equipment in this particular plant, references, etc. After these details were carefully discussed, I was asked some advanced engineering questions relative to tests, etc., all of which, apparently, I answered satisfactorily to the superintendent. Based upon this examination I naturally assumed that the job being offered me was a big one. In due time we came to the matter of just what sort of position was open, and I was astonished when the superintendent informed me that to obtain a position in the power department of this plant I would have to start as an oiler. When I expressed my surprise at this arrangement, the superintendent informed me that it was a ruling of the company and no matter how good a man was, his ability had no bearing on his getting the job.

Some interesting points come up in one's mind in thinking over a proposition of this kind. Assuming that all firms ran their business along these lines, every time the head of a department got out, everyone in the plant would step up and the new man would come in at the bottom. There are numerous objections and disadvantages to this system, as many men are good in their particular places, but are not adapted for those any higher up, and again there are many who are well satisfied with the jobs they hold and would resent being put in higher positions. Based upon my understanding of this system, a man has absolutely nothing to say about the position he shall hold; whatever the company's officers think he is best fitted for, is the work he will do. In my own experience, when good jobs came up in our plant, the man who could show the best ability for that particular job got it, whether he had been on the job ten years or one. This creates an incentive, while under the other system you simply have to wait your turn.

From my understanding of the present industrial conditions no man, no matter how good he is, is sure of his job for any length of time. I have known of cases where men have worked twenty years on a job and have been discharged on an hour's notice for no justifiable reason, yet nothing is ever done about it. Assume that a middle-aged man takes a job under the system described in the foregoing, and in time works his way up near the top, and just at this time a change in management is made and he is laid off. He is seriously handicapped when looking for a new position, as he is acquainted only with the practice in one particular plant. The offering of a position of this kind to an engineer with any standing in his line looks to me like an insult. I can understand a young man going in and working his way up; this would be apprenticeship, and unquestionably be a fine way to develop future engineers, but to ask a man that has been through the mill to serve an apprenticeship is too much for me.

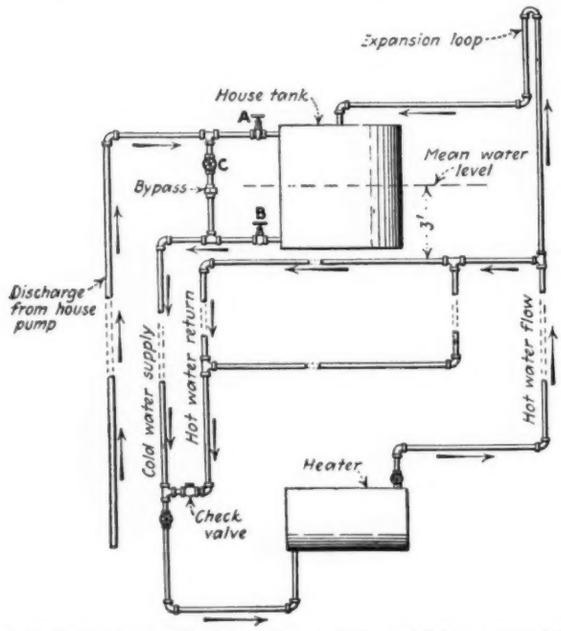
Fall River, Mass. ARTHUR D. PALMER.

Removing Air Pockets in Hot Water System

The house tank in a fifteen-story building is located on the top floor. The hot-water supply for the building is distributed under the head owing to the elevation of this tank. The supply flows from the house tank to a heater in the basement and thence through the hot-water distributing system. The horizontal return pipe

runs about three feet below the mean water level in the house tank, as indicated in the sketch.

When it was first started, the system worked well enough, but eventually it began to give trouble. Whenever it was temporarily cut out of service, it often required considerable time to get it going again. The difficulty was caused apparently by the formation of air pockets in the supply line descending from the house tank. When enough air had accumulated in this manner, the descending column of cold water, plus the



BY OPERATING VALVES THE AIR IS FORCED THROUGH SYSTEM TO HOUSE TANK

three-foot head, would be no heavier than the ascending hot-water column. Hence the two columns would stand in equilibrium.

The difficulty was removed by making a bypass connection between the supply pipe running to the heater and the discharge pipe from the house pumps, as shown in the cut. Now, should the system become air bound, it is necessary only to close valves *A* and *B* and open valve *C*, thus putting the system directly under pump pressure until all the air is forced out of the piping by the current of water, which then escapes into the house tank through the expansion loop. A. J. DIXON.

St. Louis, Mo.

An Engineer's Choice of Ammonia Condensers

The summer months bring discussions on the merits of the different types of ammonia condensers. It is claimed that the wet inside surface will condense more gas than the prohibition type. Many engineers are skeptical on this point. The liquid should be drained from coils as rapidly as possible, leaving the surface exposed for the purpose of condensing gas. It is my opinion that any arrangement of coils whereby the water will give up the greater amount of heat to the atmosphere in passing over the same, would be the most efficient condenser.

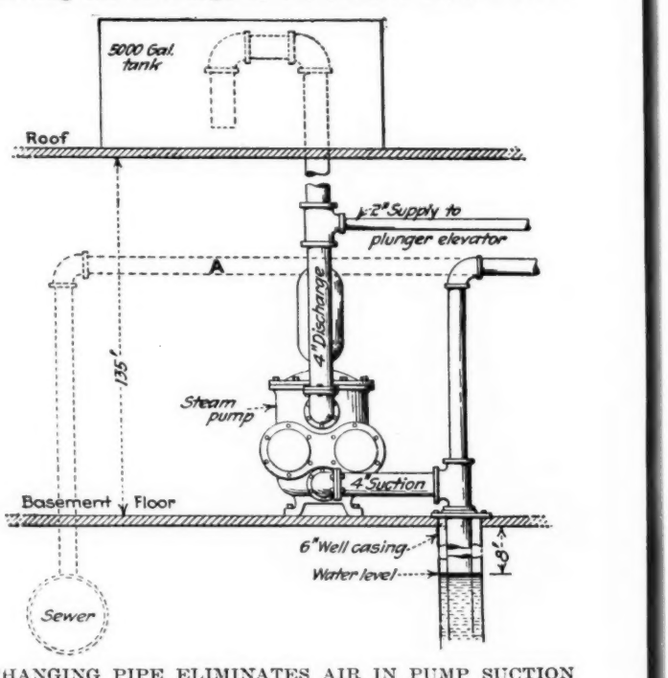
The counter-current drip type with two or more stands will seldom condense uniformly. Cooler liquid can be obtained under favorable conditions, but will generally range from 2 to 10 deg. above water temperature. Recently, on a 17-ton compressor we were carrying 15 lb. back pressure and 200 lb. head pressure. With two stands of standard parallel-flow condensers 20 long 24 pipe high, using 0.4 gal. of water per min. per ton of refrigeration, going on at 81 deg., the temperature of the liquid ammonia was 78 deg., which is giving liquid as cool as can any condenser.

Being in charge of a dozen refrigerating plants and having tried several different types of condensers for simplicity and results obtained, I believe that the standard parallel flow with superheat precooler, where water is an item and used sparingly, will compare favorably with any condenser. M. H. MILLS.

St. Louis, Mo.

Alterations in Piping of Plunger Elevator

In a new plant, in an eleven-story loft building water was pumped from an artesian well to supply a 5,000-gal. tank on the roof. A 2-in. branch was taken off the discharge near the pump, to supply a small plunger (sidewalk) elevator, the discharge of which was piped back into the well through a tee in the pump suction, evidently for the purpose of conserving the water. But it was found that operating the elevator interfered with the working of the pump, as the air in the elevator discharge would cause the suction to "break" and the pump to race. This difficulty was overcome by disconnecting the discharge of the elevator from the suc-



CHANGING PIPE ELIMINATES AIR IN PUMP SUCTION

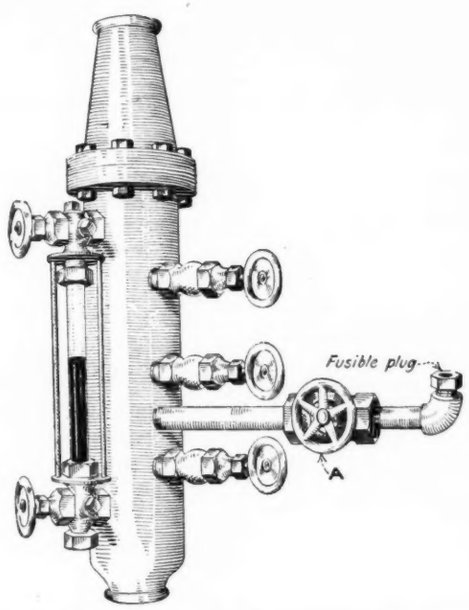
tion of the pump and continuing it to the sewer, as shown by the dotted line at *A* and inserting a plug in the tee.

Later, it became necessary to use the elevator at times when the plant was shut down. By connecting a piece of pipe on the end of the discharge in the tank, extending to within 12 in. of the bottom, water was available to run the elevator many trips, as the tank was always kept full when the plant was running.

Camden, Me. M. M. BROWN.

New Location for Fusible Plug

A boiler has recently been put in operation in Springfield, Mass., using electricity for heating. This boiler is carrying a pressure of 125 lb. and according to the State laws of Massachusetts it has to be equipped with a fusible plug. But the boiler is of the horizontal return-tubular type with the plug above the top row of tubes in the rear head and the furnace or



PLUG FUSES AT SATURATED STEAM TEMPERATURE

electric heater is on the under side of the boiler and therefore would fail to affect the plug in case of low water. This necessitated finding a new location for the fusible plug, and it was finally installed as shown in the illustration.

A connection is taken off the water column at the lowest desired water level and is fitted with a shutoff valve *A* sealed open and an elbow into which the fusible plug is screwed. The plug is filled with 90 per cent bismuth, which will not fuse under water when not exposed to fire on the other side, but will fuse at the temperature of saturated steam at 125 lb. pressure. Therefore, as long as the water is maintained at a safe level in the boiler the plug will hold, but as soon as it comes in contact with the steam it is fused and the watchman has to shut the valve after breaking the seal, thus giving proof of his negligence.

North Grafton, Mass. W. E. CHANDLER.

Piston Rod and Horsepower

Many engineers, when figuring the horsepower of their engines, forget that the crank end is less powerful than the back end; that is, assume that the cutoff, lead, release and cushion are the same at both ends, or that the indicator diagrams, when measured, show the average effective pressure on each side of the piston. Please remember that the rod takes up part of the volume of the cylinder and lessens the effective surface of the piston.

Suppose, now, that your cylinder is 30 in. in diameter and the piston rod 4½ in. in diameter, and that there is no tail rod, which I consider a nuisance, as it gives but little extra stiffness and makes one more stuffing box to keep properly packed. At the back end you have 706.86 sq.in. effective area; but at the crank end you have $4.5 \times 4.5 \times 0.7854 = 15.904$ sq.in. of piston surface neutralized by the rod; so that on that end there is only 706.86 minus 15.904 equals 690.956 sq.in. (call it 691). That reduces your effective piston area on the crank end by $1590.4 \div 707 = 2.25$ per cent, and reduces the horsepower of the engine half that much.

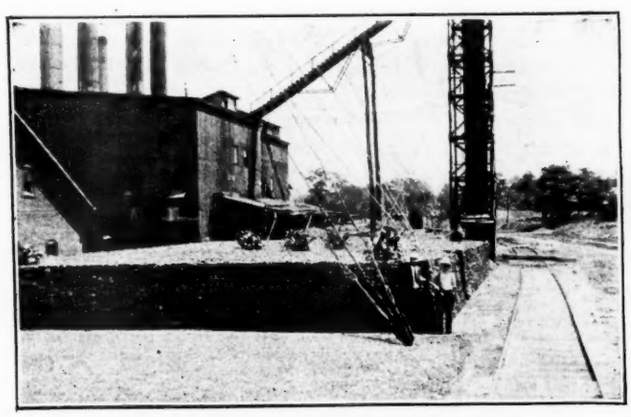
Suppose that instead of an iron rod you had a steel one, which would need to be only 3⅞ in. in diameter to do the same work. It would reduce the effective piston area of the crank end by only $3.875 \times 3.875 \times 0.7854 = 11.793$ sq.in., which is 1.667 per cent, and the effective piston area of the entire engine only 0.833 per cent. Or, putting it the other way about, you would (other things being equal) increase the horsepower of the engine in the ratio 1,397: 1,401, or 1: 1.00286, or say less than half of one per cent by substituting a steel rod for the present wrought-iron one.

And incidentally, the steel rod would be less liable to score if a bit of grit got on the soft packing, which sometimes happens when the rings are laid on the floor instead of on a paper. ROBERT GRIMSHAW.

New York City.

One Way of Beautifying Plant Surroundings

The illustration herewith shows a stockpile of coal belonging to the Ohio Service Co. at Coshocton, Ohio, as it appeared on Aug. 1, 1922. This pile consists of over a thousand tons of mine-run coal and has been stocked as shown for about three years. This view is evidence of the fact that a stockpile can be made a thing of beauty and an asset to a plant and surrounding community. The cannas, which are in bloom, have

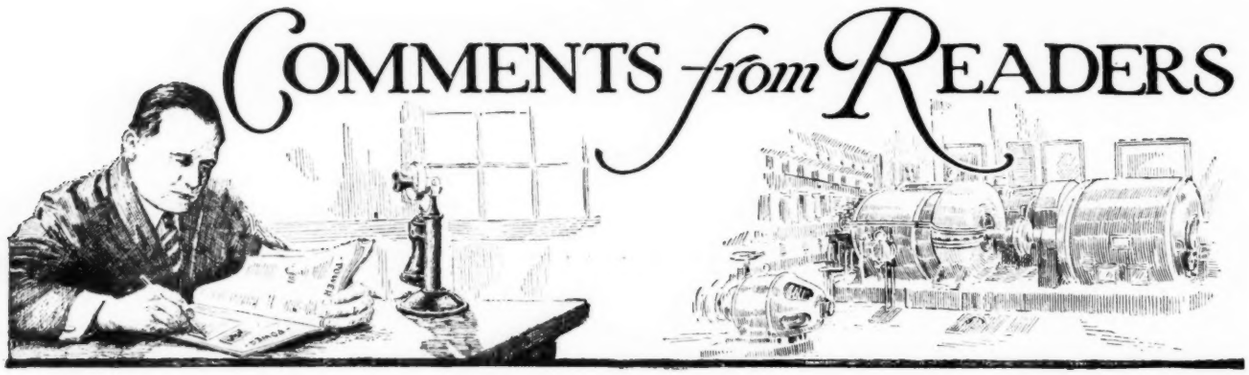


AN UNUSUAL WAY OF STOCKING COAL

grown from the bulb up to the present state in the coal pile. They were planted in barrels containing good rich soil, and watered daily by the watchman.

Practically no expense was incurred in placing this stockpile as here shown. The watchman in spare moments found time to work upon it and his efforts have been rewarded by the many compliments paid him and by the incentive it has created among the other men.

Coshocton, Ohio. J. J. DOLAN.



Making a Templet in a Few Seconds

My attention has been directed, in the June 13 issue, to the description of the Maco Patent Adjustable Templet, and I wish to point out an error in the method of working the tool as suggested by the article in which it states, "To use the device it is loosened . . . and . . . tapped gently until all the leaves have dropped down . . ."

The proper method is to loosen the setscrews slightly, and then press the leaves—known as dents—onto the surface of the material of which a section is required. Such pressure is exerted by holding the clamp with the hands in the manner shown in the illustration in the article.

If the dents are tapped, there is great danger of one or more being bent, as they are only 0.007 in. thick.

Should the screws be loosened too much there is a tendency for the whole of the dents to move en bloc, and a poor result is obtained. The exact tension is a matter of practice, but it should be borne in mind that the tighter the dents are held the better templet is secured.

E. JAMES BROWN.

Putney, England.

Reason for Unaflow Engine Economy

I have read the article on the unaflow steam engine in the issue of June 20. The explanation for the superior economy of this type, as given in the article, is the same as that generally presented.

The statement that the unadirectional steam flow is the reason for the engine's economy would be accepted by everyone if it were true that the direction of steam flow was the only marked difference between this and other reciprocating engines.

There is, however, another difference which seems to be much more closely related to the conserving of the heat stored in the cylinder walls during the forward stroke. I refer to the fact that the exhaust is open only for about one-tenth of the return stroke instead of from six to as much as nine-tenths.

A great deal of what is claimed to be true with regard to cylinder condensation and re-evaporation with its rejection of unemployed heat is certainly related to this feature of operation.

The claim that by the one-direction flow of the steam the cylinder head is not swept by the exhaust is true, but how much of the steam exhausted in ordinary construction actually sweeps over the cylinder head? Also, with jacketed heads the surface is dry and transmits heat slowly to a gas. This, however, is in favor of the one-direction engine to some degree, although the piston head has to stand for a "cold sweep."

The economy appears to come from saving of cylinder condensation, but that the saving is caused entirely or largely by making the steam flow in one direction isn't as clear as it might be.

J. C. MORRIS.

New Orleans, La.

Should Boiler Code Bar Emergency-Fleet Boilers from Land Installation?

I would like to add my comments to those expressed by F. W. Dean in the Aug. 8 issue, in objecting to the ruling of the boiler commissioner in Pennsylvania in which he decided that boilers built for the United States Shipping Board would not be eligible for installation in Pennsylvania.

Two of these Emergency Fleet boilers have been installed in a large electric sand dredge operating in the Allegheny River and have been found to be excellent boilers in every respect, and I can see no serious objection to the installation of this type of boiler on land.

It is entirely logical that the commissioner should bar any type of boiler that is not safe to operate, but I believe the boilers built for the United States Shipping Board have considerable merit, both as to design and construction, and that boilers should be passed on according to their merits and not barred as a general proposition. I do not believe it was the intention of the engineers who drafted the A.S.M.E. Code to bar all boilers that might not comply with the rules of the Code in minor respects.

JOSEPH BRESLOVE.

Pittsburgh, Pa.

Using Gasoline Engines for Breakdown Service

In answer to Mr. Busek's inquiry in *Power*, Aug. 15, concerning the advisability of installing a gasoline engine for stand-by service, I would recommend such an arrangement. I would suggest, however, that he consider only those engines running at 600 r.p.m. or under. It is my opinion that engines of higher speeds, while lower in first cost, require more attention as to adjustment of bearings, etc.

Slow-speed engines, that is, 600 r.p.m. or less—have the advantage of being able to burn lower-grade fuel. A high-speed engine will operate satisfactorily on gasoline, for the volatility of this fuel is sufficiently high to allow it to be completely vaporized and consumed even at high engine speeds. When heavier oils, such as kerosene or 39-deg. distillate, are experimented with, it has been the general experience that the time during which the fuel is inhaled into a cylinder is too short to allow it to be satisfactorily vaporized.

This results in incomplete combustion, heavy carbon deposits and irregularity in speed.

If an engine of 600 r.p.m. or under is chosen, it will be found to be most suitable for emergency service. In fact, with kerosene at its present price there is no question that the kerosene-burning multi-cylinder low-priced engine-generator unit can develop power cheaper than any type of non-condensing steam plant. The advantage is greater in localities where coal must be delivered by trucks and where a charge must be made for ash disposal. In New York City it is costing many plants two dollars a ton for ash hauling. This, with the present quality of coal, means from twenty-five to fifty cents a ton of coal burned. With coal costing six dollars a ton and a coal rate as low as 5 lb. per kw.-hr. the first cost of power per kilowatt-hour is close to 1½ cents. Adding boiler-room labor and boiler repairs, the saving of the kerosene unit over the steam plant is at least one cent per kilowatt-hour.

In addition the installation of an emergency gasoline-engine set in a steam plant will in most places enable a lower insurance rate to be obtained. The premium reduction will in plants such as textile factories pay for the set in two years or so. J. A. CASS.

Jersey City, N. J.

Water-Column Connections

There have been several discussions on water-column troubles and connections in *Power*, but I have not noticed any explained such as I experienced some time ago.

The boiler was a return tubular, and we had trouble telling where the water level was. After blowing down the column, the glass would show the correct level for possibly half an hour, then the water would rise in the glass and show a false level, while the level in the boiler would gradually drop to a dangerous point. This trouble went on for some time until we finally found that the top steam connection to the column had a sag in it of about 1½ in. This was the diameter of the pipe, so it made a trap which caused it to show a false level.

Chicago, Ill. L. B. SHIELDS.

With reference to the article by R. A. Cultra in the Aug. 15 issue, he brings out some good points on the installation of water columns and connections and on the placing of fittings where they will be the most serviceable, but I cannot agree with him on the elimination of valves and crosses on these connections, for when these are properly installed and placed in the right locations they do not detract from the safety or appearance of the installation.

In my opinion each connection should have a valve in its make up, even if the state law requires them to be sealed open. They can be closed if an emergency should arise. They should, however, be of the outside screw and yoke type or stop cock with the lever fastened on permanently. With either one of these valves it can readily be seen whether they are open or closed. When it is necessary to keep then locked, they can be operated from time to time by the engineer holding the key, and in this way they can be kept in operative condition and the column be given a good blowing down.

I also favor the placing of unions between the valve and the column for the convenient removal of the column for cleaning and repairs.

If the valves and unions are placed as close to the boiler setting as is practicable, particularly on the lower connection, it will lessen the length of pipe between the valve and the boiler and consequently lessen the liability of this part of the connection to become plugged. If, however, the connections become restricted, the valves can be closed and the column removed and the cause of the trouble readily found.

I do not believe that there is any difference from the viewpoint of safety between valves on the column connections and on the gage-glass mountings where they are essential for the replacing of glasses, for an attendant is as likely to leave one closed as the other, especially where the gage-glass cocks are operated from the floor by means of levers or chains.

By the use of crosses, which should in every case be extra-heavy fittings, the connection can often be cleared in a few minutes, and if the plugs are put in with graphite and oil on the threads, no difficulty in removing them or danger of breaking the connections should be experienced.

The necessary precautions for maintaining a safe water level cannot be too forcibly impressed upon any fireman or attendant. If he is not sufficiently alert to be sure at all times that the valves are open, can he be trusted to keep a safe water level with everything in order? G. A. TAYLOR.

Newark, N. J.

Boiler Blowdown Recorder

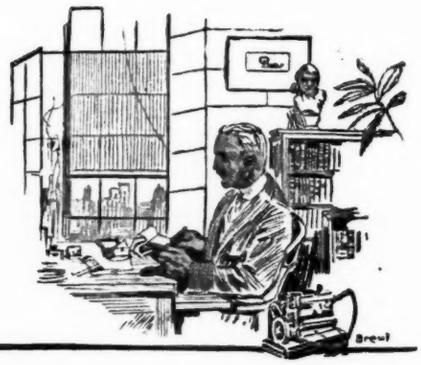
I have read with interest the description of the different devices used to record the blowing-down of boilers in different plants. I think the pressure recording gage idea is good, but in my opinion the recording thermometer is better. But what is to be done in the plants where the owners refuse to invest the amount required for either of these instruments?

WHEN BLOWING DOWN, A PORTION OF THE WATER PASSES INTO BARREL

The illustration shows one way of getting around the difficulty. If the small pipe is connected into the top of the blowoff pipe, no water will pass into the barrel from any ordinary leak in the valves, but the pressure due to blowing down will send water enough over so that by a few test blows the engineer is able to tell approximately the amount of blowdown during his absence, and it is better than no means at all, especially when in doubt as to the regularity of the blowing-down.

North Grafton, Mass. W. E. CHANDLER.

QUESTIONS AND ANSWERS



Construction of Brick Stacks

Why are brick stacks made larger at the bottom than at the top? E. E. R.

Brick stacks, like self-sustaining steel chimneys, are made larger at the base for greater stability, especially for resisting wind pressure. In brick stacks the inside diameter generally is made uniform. The exterior walls, and also the core walls, usually are made to diminish in thickness at intervals from the base upward, with offsets of the exterior walls toward the inside and offsets of the core walls toward the outside.

Leakage of Rear Tube Ends Burning Bituminous Coal

During periods of shortage of anthracite, we have burned bituminous coal for our return-tubular boilers, and whenever it is used we are troubled with leakage of the tube ends in the rear tube sheets of the boilers. How can this be remedied? W. L. D.

The trouble undoubtedly results from incompletion of combustion in the furnaces combined with carrying of coal dust to the back connections where the combustion is completed, resulting in exposure of the tube ends to extraordinary heat. This may result from stoking too much coal at a time and undertaking to force the boilers with insufficient air supply. If there is a strong draft, particles of coal may be carried into the back connection and burned there in place of burning on the grates. This may be largely prevented by wetting down the coal before it is fired.

Pressure of Heating Boilers

What are the respective advantages of low-pressure and high-pressure boilers for heating purposes? P. P.

When steam is generated, the lower the pressure the lower the temperature of the water and steam in the boiler. Hence, with a lower-pressure boiler there is greater difference between the temperature of the fire and heated gases and that of the water in the boiler with rather more rapid absorption of heat, and also may be greater economy from a lower temperature of waste chimney gases. As the latent heat of evaporation is higher for low-pressure than for high-pressure steam, there is less water of condensation to be handled for a given service, and the condensate being at lower temperature, there is less loss of heat from carrying return pipes from a heating system through places where the heat in the return water is wasted. Lower-pressure boilers also have the advantage of being cheaper of construction and safer against damage from explosion.

High-pressure boilers have the advantage of supplying steam for distribution through smaller pipes, and with the steam of higher temperature, smaller radiators are required for a given service. With the steam of higher pressure, boiler-feed pumps, house pumps, etc., that are to be supplied can be smaller, and with the boiler pressure carried high enough for any special purpose or to meet the requirements of some particular sections of heating apparatus, the pressure can be regulated by reducing valves for heating or other service for which steam of lower pressure may be desired.

Cored Cables for Direct-Current Circuits

Do the conditions that make cored cables advisable for alternating-current circuits obtain in the case of direct-current circuits? I am aware that in the larger sizes of cables for alternating-current service, hemp cores are used. It had not occurred to me that the same conditions might exist in a direct-current circuit until I saw cored cables installed in the exciter leads here at the station where I am employed. B. T. P.

For exciter leads the cheapest cable of suitable area and insulation is usually chosen without regard to whether it contains hemp core or not. The slight advantage of greater cooling area and flexibility are not generally recognized as reasons for installing a hemp-core cable. We do not know the local conditions that may have made such a cable desirable for the service you mention; possibly convenience made it advisable. The skin effect that sometimes makes coring or other changes desirable in alternating-current circuits does not appear as a factor in cables for the direct current of exciter leads.

Use of Foot Valves and Air Chambers

In operation of a duplex pump is it necessary to have a check valve on the suction pipe or an air chamber on the discharge side of the pump? T. H. B.

The purpose of a check or foot valve on the suction line is to prevent drainage of the water when the pump is standing idle, so the pump may be started promptly when desired, without requiring priming of the suction line or taking the risk of the pump becoming airbound when it is started up. When the suction water is supplied to the pump under pressure, no foot valve is necessary, but a foot valve should be employed if there is danger of drainage of the suction pipe when the pump is not running.

In operation of a duplex pump the action of the pistons is nearly continuous and the flow of the discharge is nearly uniform. When duplex double-acting, low-service pumps or small duplex pumps, such as used for boiler feeding, are properly operated, it is not generally necessary to employ air chambers on the discharge side of the pump for the purpose of steadying the flow.

Selling Precooled Water at the Price of Ice

How much can the return from an ice plant be increased by reducing the temperature of the water from 75 deg. F. to 35 deg. F. before it goes into the cans by passing it through coils in tanks filled with ice, instead of reducing the temperature to 35 deg. F. by means of direct expansion precooler, if the water from the melted ice can be sold for the price of ice? The ice to be melted would be made in the same tank.

N. W.

Assume that the can of water which is to be frozen and then used to cool other water, is put into the can at 35 deg. In cooling the water to 32 deg. F., each pound would receive 35 — 32 = 3 B.t.u. and in freezing 144 B.t.u. are received, a total of 147 B.t.u. Assuming that the ice in cooling the other water to 35 deg. reaches 35 deg. upon melting, we have for precooling 147 B.t.u. To precool 1 lb. from 75 to 35 deg. requires the removal of 75 — 35 = 40 B.t.u., and the 147 B.t.u. taken up by the pound of ice melting will cool $\frac{147}{40} = 3.87$ lb. As you would sell this melted ice and must replace it by a pound of the cooled water, the net precooled water that could be frozen and sold as ice is 3.67 — 1 = 2.67 per pound of ice melted. Freezing these 2.67 lb. will call for the removal of 384 B.t.u. You have then removed in the ice tank the 384 B.t.u. plus 144 B.t.u. of the pound to be melted, or 528 B.t.u., for 3.67 lb. of ice, or 144 B.t.u. per pound of water. By not precooling, each pound requires 144 + 40 = 184 B.t.u., so the gain in the *ice tank* capacity is $\frac{40}{184}$, or about 20 per cent.

But it is to be noted that for each 2.67 lb. of ice sold, there would be 1 lb. of cold water to sell. In a 100-ton ice plant this would amount to 6.6 tons of water, or about 1,600 gal. of cooled water per 24 hours.

Unless all of the water is sold at a price not less than 80 per cent of the ice price, there would be no saving. Note that the capacity of *ice* for sale is decreased in the ratio of 184 to 200.

Resetting Slipped Eccentric

How can a slipped eccentric be set on a D slide-valve engine for obtaining proper action of the valve without stopping to remove the steam chest cover? R. G. N.

If the only defect in the valve setting is that the eccentric has slipped from its proper setting on the shaft, the best method of finding the proper location of the eccentric would be from indicator diagrams.

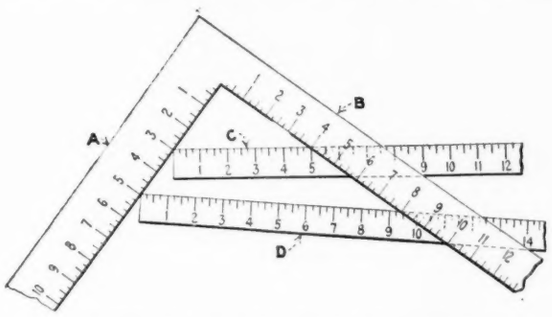
Without indicating the engine, the approximate setting can be obtained by placing the engine on a center and twisting the eccentric around on the shaft in the direction of forward rotation of the engine, and each time setting the eccentric to a different position, blocking the engine and slightly opening the throttle valve to find the position of the eccentric for which steam is just admitted to the proper end of the cylinder for the beginning of a stroke, by observing the escape of steam from an indicator cock or cylinder pet cock on the same end of the cylinder. Before running make the same test with the crank on the other center.

If it is not practicable to place the engine on a center, to reset the eccentric approximately, and with sufficient accuracy for running the engine temporarily, turn the eccentric around on the shaft in the direction of rotation of the engine and by trial, with the engine wheel blocked and throttle open a very little and indicator or pet cocks open, find the position for setting for which steam is just admitted for the beginning of the stroke that has been partly accomplished. Then estimate how far the crank would have to be twisted backward around on the shaft to bring the crankpin on the center and set the eccentric the same number of degrees forward of the position previously determined.

Equating Pipe Areas

What practical method can be employed, without resorting to tables or computations, to determine the diameter of a main pipe line that will have a cross-sectional area equal to the combined areas of two or more branch pipes of given diameters? W. R. H.

The areas of circles are to each other as the squares of their diameters, and for a main to have a cross-sectional area equal to the sum of cross-sectional areas of the branches, the square of the diameter of the main must be equal to the sum of the squares of diameters of the branches. The square of the hypotenuse of a right-angle triangle is equal to the sum of squares of the other two sides, and if the sides about the right



A METHOD OF EQUATING PIPE SIZES

angle are taken respectively equal to the diameters of two branch pipes, the hypotenuse will be equal to the diameter of a main whose cross-sectional area will be equal to the sum of the areas of the branches.

The figure illustrates a practical method of approximately determining the diameter of main whose cross-sectional area will be equal to the sum of the cross-sectional areas of branches based on the relation of sides of a right-angle triangle, by employment of an ordinary steel square and a rule. Suppose the branch pipes are respectively 3, 4 and 8 in. in diameter. Measuring with a rule *C* from the 3-in. division on the arm *A* of the square to the 4-in. division on the arm *B*, the length of hypotenuse is found to be 5 in., which would be the diameter of a main whose area is equal to the sum of areas of branches respectively 3 and 4 in. in diameter. Then measuring across the steel square from division 5 on the arm *A* to division 8 on the arm *B*, with the rule placed as shown at *D*, the diameter of main having an area equal to the combined areas of all three branches, 3, 4 and 8 in. in diameter, is found to be on *D* about 9½ in., indicating that a 10-in. pipe would be the nearest commercial size required to cover the combined cross-sectional areas of the branches.

[Correspondents sending us inquiries should sign their communications with full names and post office addresses. This is necessary to guarantee the good faith of the communications and for the inquiries to receive attention.—Editor.]

Leather Belting Specifications*

1. These specifications are for use as the basis of purchase for miscellaneous sizes, single and double ply, of first quality vegetable tanned (so-called oak tanned) leather belting for general use; also waterproof-dressed and waterproof leather belting.

II. Standard Specifications

A. Quality of the Leather

2. All belting leather shall be made from green salted hides, and be free from brands, soft or spongy spots and open grub holes, excepting that when made into belting, 30 per cent of the strips in any belt or roll of belting may contain a maximum of three open grub holes in each of such strips.

3. The hides shall be tanned with oak bark or a combination of vegetable tanning materials.

4. Stuffing—Animal oils and greases shall be used for stuffing the leather, or a mixture of these and mineral oils in such proportion as will provide maximum strength and pliability.

5. Adulteration—The use of epsom salts, glucose, barium chloride or other materials for weighting the leather is prohibited. The presence of a greater amount of stuffing content than hereinafter specified shall be considered as adulteration.

6. Stretching—All leather after stuffing shall be thoroughly stretched while still damp and left under tension until dry. All belt pieces shall have the stretcher marks cut off.

7. Finish—The grain or hair side shall be finished smooth, and the leather shall be thoroughly fleshed.

8. Cutting—All strips shall be cut from the center portion of the hide, at such distance from the backbone as to include only firm stock and to exclude second-quality leather, and at such distance from the root of the tail as will exclude all shoulder stock, provided that the length of the strips shall be as hereinafter specified.

B. Construction of the Belting

1. Strips

9. Length—No sectional strip shall be more than 54 in. in length, including the lap. The minimum length of any strip shall be 36 in., including the lap, excepting that in double belts one-eighth of the total number of pieces may be between 20 in. and 36 in., provided that these short pieces shall not occur consecutively. The minimum length shall not apply to the end pieced of rolls or cut lengths.

10. Joining—In single belting the strips shall be joined shoulder end to shoulder end and butt end to butt end. In double belting the pieces shall be joined shoulder end to butt end.

11. Selection—In all single belts 8 in. and over in width, backbone center strips shall be used. The backbone mark must appear running lengthwise approximately in the center of each strip. In all double belts from 8 in. up to 10 in. in width, backbone center strips shall be used in one ply and the backbone mark shall appear running lengthwise approximately in the center of each strip. The other ply shall be cut from the location prescribed for first-quality stock. In all double belts 10 in. and over in width both plies shall be made from backbone center strips, and the backbone mark shall appear running lengthwise approximately in the center of each strip. The same quality of leather shall be used in both plies of all double belting.

2. Laps

12. Length—The length of laps shall be within the following limits.

TABLE I—LENGTH OF LAPS IN INCHES

Ply	Thickness	Length of Laps, Inches: Belts, Under 6 in.	Belts, 6 in. and Over
Single	Under 10/64 in.	2½ to 6	3 to 8
	10/64 in. and over	3 to 8	3½ to 10
Double	Up to 17/64 in.	2½ to 3½	3 to 4
	19/64 in. and over	3 to 4	3 to 5

13. Location—The minimum distance between any two laps in the separate plies of double belting shall be 8 in.

14. Point of Lap—The points of all laps shall be at right angles to the edge of the belt.

15. Direction—All laps shall run in the same direction.

3. Cementing

16. The laps of both single and double belts and the plies of double belts shall be thoroughly cemented together. When pulled apart, the cemented surface shall not appear glazed or shiny.

17. Standard Widths—The standard widths of belt shall be from ½ in to 72 in., increasing by ¼ in. up to 3 in., ½ in. to 6 in., 1 in. up to 10 in., and 2 in. above 10 in.

18. The maximum variation from the nominal width shall be in accordance with the following:

TABLE II—TOLERANCE FROM NOMINAL WIDTH

Width of Belting in inches	Tolerance
Under 2 in.	Not less than nominal
2 in. to 24 in., inclusive	One per cent
Above 24 in.	½ of one per cent

19. The thickness for the different grades of belting shall be in accordance with the following table:

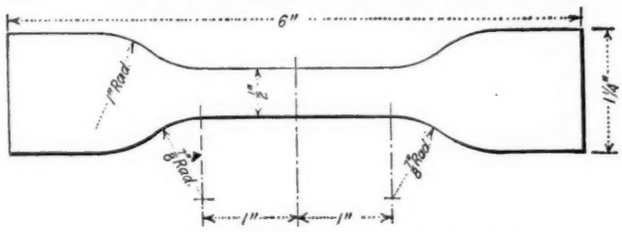
Grade	Average Thickness in Inches: Single-Ply, Inches	Double-Ply, Inches
Light	8/64 up to 10/64	15/64 to 17/64
Medium	10/64 up to 12/64	19/64 to 21/64
Heavy	12/64 up to 14/64	23/64 to 25/64

The average thickness shall be determined by measuring the thickness of 15 to 20 plies of the belt when rolled, and dividing this value by the number of plies measured.

20. Uniformity—No point in either single or double belt shall be more than $\frac{2}{64}$ in. thicker nor more than $\frac{2}{64}$ in. thinner than the average thickness.

21. Leveling and Filling—The excessive use of shims and filler strips and excessive splitting or leveling is prohibited.

22. All belting shall be stamped on the grain side with the maker's name and brand, and a stamp indicating the direction in which the belt is to run. Each stamp shall be repeated every ten feet throughout the entire length of the belting.



DIMENSIONS OF TESTING SPECIMENS

23. Waterproof-Dressed Belting—This type of belting shall conform to all the requirements of this specification. In addition it shall be treated with a waterproof dressing.

24. Waterproof Belting—This type of belting shall conform to all the requirements of this specification. In addition, it shall be treated with a waterproof dressing. The laps and plies shall be cemented with a waterproof cement.

III. Technical Tests

A. Physical Tests

25. Leather—All leather shall have a minimum tensile strength of 3,000 lb. per sq.in. of cross-section and an average tensile strength for single belts of 3,750 lb. per sq.in. and for double belts of 3,500 lb. per sq.in. The average shall be determined with five test specimens selected at random from different parts of the sample being examined. Test specimens of the size and shape as shown in the figure shall be cut with a metal die. The edges of the test specimen shall be cut perpendicularly. The minimum thickness inside the gage marks shall be used in determining the area of the cross-section of the test specimen.

*Abstract of a leaflet prepared by collaborator of the Bureau of Standards, Washington, D. C., 1922, for Government purchasing.

26. Laps and Plies—The laps of both single and double belting shall not open when subjected to a tensile stress of 2,500 lb. per sq.in. The opening of the laps shall be determined by testing two specimens cut across the point of the lap lengthwise of the sample. For double belting the test shall be made on the single ply.

27. The average elongation at a tensile stress of 2,500 lb. per sq.in. shall not exceed 15 per cent. The average shall be determined with the same five test specimens used for determining the tensile strength.

To determine the amount of elongation, parallel gage marks 2 in. apart shall be placed upon the restricted portion of the test specimens. The distance between the gage marks shall be measured with a pair of spring dividers, at a tensile stress of 2,500 lb. per sq.in. The amount of stretch shall then be determined by measuring the opening of the dividers on a scale.

This test will be made on each lot of two thousand feet or fraction thereof.

28. The following stretch test shall be made on the finished belting up to and including six inches in width: Any section of a roll or belt shall be selected (which shall not be cut out) on which gage marks shall be placed 10 ft. apart. Suitable clamps shall be attached on the marks so that the distance between the clamps shall be 10 ft. The section shall then be suspended in a vertical position from one of the clamps. Sufficient weight, including the weight of the clamp, shall be attached to the lower clamp to produce a tensile stress of 750 lb. per sq.in. of the average cross-section of the section being tested. The section, after being subjected to this tension for 15 min., shall show a length between gage marks not to exceed 10 ft. 7.2 in. (6 per cent stretch).

29. Measure of Elasticity—The clamps shall then be removed and the section allowed to lie loosely on the floor for 17 hours, after which time the length between the gage marks shall not exceed 10 ft. 1.6 in. (1⅓ per cent stretch).

30. The leather shall not crack on the grain side, and the laps shall not open at the points, when the belting is bent through angles of 180 deg., grain side out, over forms as hereinafter specified for the different grades and thicknesses.

TABLE IV—FORMS FOR CRACKING TEST

Belt	Thickness, Inches	Diameter Form, Inches
Single	Under 10/64 (Average)	1
	10/64 and over	1½
Double	Up to 17/64	3
	19/64 and over	4

31. The leather shall not show wrinkles on the grain side (commonly called "piping," and indicating looseness of fiber found in "side-stock," or second quality belting) when bent through an angle of 180 deg. grain side in, over forms as specified below for the different grades and thicknesses.

TABLE V—FORMS FOR PIPING TEST

Belt	Thickness, Inches	Diameter Form, Inches
Single	All	2
Double	Up to 17/64	4
	19/64 and over	6

32. A sample of waterproof-dressed or waterproof belting, 12 in. long, shall be weighed and then immersed in water, at room temperature, for five hours. When removed from the water, the sample shall be wiped and again weighed. The water absorbed shall not exceed 8 per cent. This test shall be made on every lot of 2,000 ft., or fraction thereof.

33. The sample of waterproof belting tested for water absorbtion shall be again immersed in water, until the total period of immersion is 24 hours. The sample, after removal, shall be allowed to dry under room conditions for 24 hours. The laps and plies shall not open when the sample is bent around the proper form, as specified in Par. 30—Cracking.

B. Chemical Tests

34. The chemical analyses shall be made in accordance with the standard methods of the American Leather Chemists' Association, and percentages calculated on the basis of moisture-free leather.

35. The stuffing content shall not exceed 18 per cent nor be less than 8 per cent of the weight of the finished leather. The currying mixture shall not contain more than 35 per cent of unsaponifiable matter.

In the case of belting which has been waterproof-dressed, the grease content shall not exceed 25 per cent, and the unsaponifiable matter shall not exceed 35 per cent.

36. The total ash shall not exceed 1 per cent of the weight of the finished leather.

37. The free mineral acid shall not exceed ¾ of 1 per cent.

38. Glucose, resulting from tanning materials, shall not exceed 2 per cent.

C. Samples

39. A representative sample from each of all shipments of 2,000 ft., or fraction thereof, 36 in. in length, and including at least one lap, shall be selected by the Government inspector for physical and chemical tests.

IV. GENERAL

40. When bids are requested, the buyers shall specify the ply, length, width and grade desired on each item, and whether the belting shall be waterproof-dressed or waterproof belting.

41. Unless otherwise specified, the belting shall be packed in accordance with the standard practice of the manufacturer. It shall be marked:

Name of Contractor .....
Type and Size of Belting .....
Contract No. .....
Requisition No. ....., or Schedule No. .....

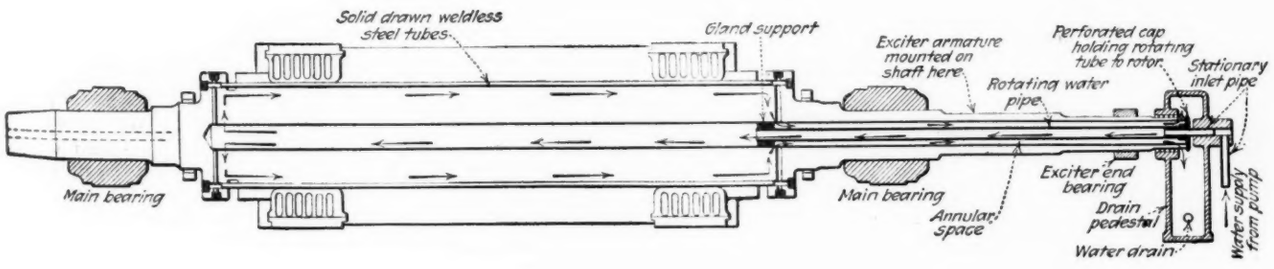
The belting shall be shipped in accordance with the instructions of the purchaser.

42. All inspections shall be at the point of manufacture wherever possible, but the government reserves the right to inspect at point of delivery, in which case material, if rejected, shall be removed by the contractor at his own expense.

Revolving Field Cooled by Water in European Turbo-Generator

A hollow shaft contains a centrally located revolving tube into which water is forced, by means of a stationary inlet pipe. This water travels the entire length of the rotor and returns through twenty small seamless tubes, embedded near the winding slots.

The heated water is discharged into the annular space between the revolving supply pipe and the hollow shaft, and travels to the hollow drain pedestal, where it is discharged. Such designs are not uncommon in large units abroad; this being described in *The Engineer*, London, June 2, 1922.



News in the Field of Power

Winnipeg Hydro-Electric System To Add Steam Stand-by Plant

As an auxiliary to its present hydro-electric system the city of Winnipeg has decided to install a 30,000-hp. steam stand-by plant. Such an installation has been found necessary because of the demands of many consumers of electric power in Winnipeg for an uninterrupted service. The estimated cost of the plant is $1,500,000 and although this investment will involve an increase in annual expense of $20,000, the Winnipeg Hydro-Electric System believes that it will be able to maintain its present rates without change.

The installation of a central steam-heating plant, to supply steam for heating public and office buildings in Winnipeg, is also being considered. It is planned to co-ordinate this plant, at a later date, with the steam stand-by plant.

Hoover Urges State Control of Coal Prices

That the governors of the individual states must co-operate in any attempt on the part of the federal government to control coal prices is the firm belief of Secretary of Commerce Hoover, as expressed in a recent letter to Governor Davis, of Ohio.

Present indications are that President Harding's proposed legislation for price restraint will not be passed, but even if it were, such control would be necessarily limited to shipments of coal from one state to another. No protection would be afforded the citizens of a coal-producing state, such as Ohio. The mines in that state now opening under the Cleveland agreement are demanding from $7 to $10 a ton for coal. Under such conditions it is only natural that public utilities in Ohio should ask for priority orders against southern coal fields, where the price asked is around $3.50 a ton. Secretary Hoover says, "You will recognize that in this situation, if we are to give priority as requested, it would not be just either to the operators or to persons in great need of coal in other states, in view of the additional supplies in Ohio."

Secretary Hoover says that he has had some communication with operators in Ohio who are anxious to do the fair thing by the public, and who, he believes, would welcome some sort of arrangement for establishing fair prices. He concludes his letter to Governor Davis as follows:

I cannot too strongly urge that if the people of Ohio and surrounding states are to be protected there should be secured a voluntary arrangement with the necessary committees to enforce it, under the direction of your fuel committee, by which some fair maximum price is fixed and similar voluntary arrangement and enforcement is set up in respect to wholesale and retail handling of coal. The Federal Fuel Distributor would gladly co-operate in making available such pressure as exists under priorities.

"Public Welfare Must Come First," Says President Harding

IT IS of public interest to preserve the unions and profit by the good that is in them. We recognize these organizations in the law, and we must accredit them with incalculable contributions to labor's uplift. But we must also check the abuses and the excesses which conflict with public interest, precisely as we have been progressively legislating to prevent capitalistic, corporate or managerial domination contrary to public welfare. We also recognize the rights of employers and employees alike, within the law, to establish their methods of conducting business, to choose their employment and to determine their relations with each other. We must reassert the doctrine that in this respect the first obligation and the first allegiance of every citizen, high or low, is to his government, and to hold that government to be the best and unchallenged sponsor for public welfare and the liberty, security and rights of all its citizens. No matter what clouds may gather, no matter what storms may ensue, no matter what hardships may attend or what sacrifices may be necessary, government by law must and will be sustained.

—From the President's address to Congress on the coal and rail strikes, August 18, 1922.

Seek House Action on Ford's Muscle Shoals Offer

Proponents of the Ford offer for Muscle Shoals are awaiting opportunity to have the Detroit manufacturer's proposition brought to a vote on the floor of the House. In view of the legislative situation it will require a special rule to bring this issue up and such a rule admittedly will be difficult to obtain.

While the general plan of procedure of the Ford advocates has been placed in the hands of Representative Garrett, of Tennessee, acting minority leader, there is available also the assistance of a number of Republican members who have displayed keen interest in the matter. So far, Representative Garrett has no definite plan. In discussing the matter, he stated that his tactics would consist of waiting for an opportunity to move on the floor for instructions to the rules committee, and to urge the subject upon the rules committee, of which he is the ranking minority member.

Chairman Campbell, of the rules committee, is understood to be opposed to the Ford offer and the majority of that committee does not appear to favor it. Added to this disadvantage is the fact that the steering committee, which has great influence with the rules committee in determining the precedence of legislation for the consideration of the House, has refused to exert pressure in behalf of any of the Muscle Shoals bills.

Experiencing Difficulty With English Coal

Several plants that are meeting the present fuel emergency through the use of English coal are finding that certain modifications will have to be made in their stokers if they are to carry the loads as with American coal. This is true wherever high rates of forcing are employed.

At the plants of the Interborough Rapid Transit Co., New York City, approximately a third of the boilers are being supplied with Welsh coal. According to analysis this is a high-grade coal, running about 14,500 B.t.u., 15 per cent volatile and 6 per cent ash. Up to 200 or 225 per cent rating of the boilers the coal gives excellent results, but above this rating it cakes and does not permit the proper amount of air through the fuel bed. At these plants the boilers are forced as high as 320 per cent rating and it is, therefore, impossible to get more than 70 to 75 per cent capacity. It was found that the older type overfeed stokers handled this coal better than the underfeed stokers.

It became apparent that this condition would be aggravated, possibly to the point of a power shortage, as the reserve supply of American coal was used up and more and more boilers would have to be run with English coal. Therefore, the engineering force of the Interborough has endeavored to meet the difficulty by increasing the air passages through the stokers, cutting down the velocity and the pressure from five to three inches and increasing the volume of air. Tests under these conditions are now being made for the Transit Commission by Professor Lucke of Columbia University.

Calvin W. Rice Given Farewell Banquet

As a fitting send-off on the eve of his departure for Rio de Janeiro, where he will represent the American Society of Mechanical Engineers at the Engineering Congress held in connection with the Brazilian Centennial Exposition, Calvin W. Rice, secretary of the Society, was tendered a farewell banquet on Monday, Aug. 21, by a goodly number of his friends at the Engineers' Club of New York.

John W. Lieb, vice-president of the New York Edison Co., acted as toastmaster. In his introductory remarks Mr. Lieb said that the nations of South America had continued to live under the influence of their motherlands and that the effects of that influence upon engineering enterprise would be noticed by American engineers visiting Brazil.

Messages of regret were read from Dr. L. S. Rowe, director general of the Pan-American Union, James H. McGraw, president, and F. (M. Feiker, vice-president, of the McGraw-Hill Co., Inc., and Dr. D. S. Jacobus, of the Babcock & Wilcox Co.

Universal appreciation of the importance of the mission upon which Mr. Rice was starting and on his eminent fitness for the task was expressed by Dean Dexter S. Kimball, president of the American Society of Mechanical Engineers; by Ambrose Swasey, of Cleveland, father of the Engineering Foundation; by Charles F. Rand, chairman of the Engineering Foundation; by J. V. Davies, president of the United Engineering Societies; by Dr. Albert R. Ledoux, past president of the American Institute of Mining Engineers; by Gano Dunn, past president of the American Institute of Electrical Engineers and now president of the J. G. White Engineering Corp.; and by E. J. Mehren, editor of *Engineering News-Record* and vice-president of the McGraw-Hill Co., Inc.

In his speech of acknowledgment Mr. Rice read the newest and the best definition of engineering, as expressed in Prof. Cassius J. Keyser's recently published book, "Mathematical Philosophy": "Engineering is the science and art of directing the time-binding energies of mankind—the civilizing energies of the world—to the advancement of the welfare of man." Mr. Rice said that he was going forth to aid national, international and worldwide co-operation for the advancement of the profession upon the lines which this definition infers.

For purposes of representation at the Congress Mr. Rice has been elected an honorary vice-president of the Society. In addition to the A.S.M.E. Mr. Rice will represent at the Congress the Federated American Engineering Societies, the American Institute of Electrical Engineers, the Engineering Foundation, the John Fritz Medal Board, the Engineering Division of the National Research Council, and the Engineers' Club of New York City.

At the close of the Engineering Congress Mr. Rice will probably visit the various South American engineering societies in Montevideo, Buenos Aires, Santiago and Lima.

The American Society of Civil Engineers has appointed Verne L. Havens, editor of *Ingenieria Internacional*, as its representative at the Engineering Congress, and the American Institute of Mining and Metallurgical Engineers has conferred a similar honor upon Thomas T. Read.

How Ford Is Meeting the Coal Shortage

Although the Ford Motor Co. owns and operates coal mines in Kentucky and transports coal for the home plant over Ford-operated railways, the company has nevertheless felt the effect of the present labor situation. The weak link in Ford's coal distribution system is a short span of 80 miles, covered by another railroad which has been unable to make deliveries in sufficient quantities to fulfill requirements. To meet the emergency, it was decided to conserve the available stock of coal for the coke ovens and the gas producers, and in the boiler plants at River Rouge and Highland Park to burn coke braise, oil and tar skimmings from the producer plant.

At the River Rouge plant, described in *Power* for Nov. 1, 1921, the furnaces were designed to burn powdered coal and blast-furnace gas simultaneously. A total of 250 tons of powdered coal per day, in addition to the blast-furnace gas, has been required to carry a load of 25,000 kw. and to supply steam for turbo-blowers, auxiliaries for coke ovens, etc. It was decided at this plant to replace the powdered coal with fuel oil, and the change was made in two days. Twelve ¼-in. steam atomizers of Ford design were provided per boiler, each having a steam-generating capacity of 15,000 lb. per hour, or a total of 180,000 lb. per boiler. By locating the oil burners in the auxiliary air openings already provided in the furnace fronts for burning the powdered coal, it was possible to install them without interruption of service. Sufficient powdered coal was left in the bunkers to meet any emergency that may arise from clogging of the oil-supply lines.

At the Highland Park plant it was decided to utilize the available stock of coke braise, supplying it to the underfeed stokers, and to supplement this fuel with oil and tar skimmings from the producer plant. An oil burner was inserted through the side wall of each furnace on either side of the center, about two feet back of the front wall and two feet above the fuel bed. Two additional burners, one on each side, were placed near the rear wall, but these will be brought into action only in the event of extremely high overload. With this arrangement the braise protects the stoker parts in the furnace, so that there is no occasion for bricking them over, and the oil jets produce much the same effect as an ignition arch, keeping the solid fuel at a good combustion temperature. To burn the tar skimmings, an additional burner was placed in each furnace, about two feet above the fuel bed and at the longitudinal center. The tar is brought over from the producer house in a fluid condition, and to keep it at the required high temperature the tar pipe was enclosed in the same covering with the pipe supplying steam for atomization. The entire change on the fourteen boilers was made in three days, without interference with boiler operation.

Coming Conventions

National Safety Council, 168 N. Michigan Ave., Chicago, Ill. Eleventh Annual Safety Congress, Detroit, Aug. 28-Sept. 1.

National Association of Stationary Engineers; Fred W. Raven, 417 South Dearborn St., Chicago, Ill. Annual convention and exhibition at Des Moines, Ia., Sept. 11-16. Annual conventions and exhibitions of the State Associations scheduled as follows: **Iowa**, at Des Moines, Sept. 10-11; Abner Davis, Room 16, Waterhouse Block, Cedar Rapids, Iowa.

International Union of Steam and Operating Engineers, Dave Evans, 6334 Yale Ave., Chicago, Ill. Biennial convention and exhibition at Minneapolis, Minn., Sept. 11.

Association of Iron and Steel Electrical Engineers, 1007 Empire Bldg., Pittsburgh, Pa. Annual convention and exhibition at Cleveland, Ohio, Sept. 11-16.

New England Water Works Association, Boston. Annual convention at New Bedford, Mass., Sept. 12-15.

New Publications

Hydraulics. By Horace W. King, Professor of Hydraulic Engineering, and Chester O. Wisler, Associate Professor of Hydraulic Engineering, both of the University of Michigan. Published by John Wiley & Sons, Inc., New York City. Cloth; 6x9 in.; 237 pages; 133 illustrations. Price, $2.75.

The best groundwork for a practical knowledge of hydraulics is obtained by a study of the fundamental laws of liquids at rest and in motion. A number of good textbooks on the subject are already in existence, but there is room for new ones if they present the old facts from a new angle.

Although this book contains many formulas and assumes some knowledge of trigonometry and calculus, it is not unduly mathematical in the sense that the physical meaning of the various subjects is buried in symbols. In fact, great care is taken to derive the formulas in such a way that their relation to the underlying physical principles will be evident.

The following chapter titles indicate the scope of the book: Principles of Hydrostatic Pressure; Pressure on Surfaces; Immersed and Floating Bodies; Relative Equilibrium of Liquids; Principles of Hydrokinetics; Flow of Water

Through Orifices and Tubes; Flow of Water Over Weirs; Flow of Water Through Pipes; Flow of Water in Open Channels; Tydrodynamics.

The student who masters the contents of this volume will have an excellent foundation for the study of hydraulic machinery.

Personals

H. K. Jennings has been promoted from the position of assistant power enginer to that of power engineer in the Firestone Tire and Rubber Co.'s plant at Akron, Ohio.

C. Schillenger, formerly engineer of steam equipment with the Delaware, Lackawanna & Western Railway Co., is now a sales engineer with the Combustion Engineering Corp., New York City.

Trade Catalogs

Automatic Combustion Control—Automatic Fuel Saving Co., Philadelphia, Pa. A 28-page bulletin, describing the Gray system of automatic combustion control, for maintaining constant draft in boiler furnaces.

Powdered Coal—Raymond Bros. Engineering Co., Chicago, Ill. A well gotten up catalog covering the application of Rayco Pulverized Coal Systems to industrial furnaces as well as boiler plants. Typical installations are illustrated and a table summarizes the results obtained in a great variety of plants.

Duplex Strainers—Andale Engineering Co., Philadelphia, Pa. An 11-page bulletin describing the various types of Andale Duplex Strainers used with water, oil or any other liquid carrying foreign substances in suspension, for the protection of meters, fire pumps, sprinkler systems, surface, barometric and jet condensers, and oil-firing systems. The use of duplex strainers insures continuous service, as they can be cleaned without interrupting the flow.

Fuel Prices

FUEL OIL

New York—Aug. 24, Port Arthur light oil 22@25 deg. Baumé 4c. per gal.; 30@35 deg., 5c. per gal. f.o.b. Bayonne, N. J.

Chicago—Aug. 19, for 24@26 deg. Baumé, $1.50 per bbl.; 32@36 deg., 3½c. per gal. in tank cars, f.o.b. Oklahoma refinery, or freight adjusted.

Pittsburgh—Aug. 14, f.d.b. refinery, Pennsylvania, 36@40 deg., 5¾c.; Kentucky fuel oil, 26@30 deg., 4c. per gal.; Gas oil, 32@34 deg., 2¾c. per gal.; 36@38 deg., 3c.; 38@40 deg. 3¼c. Western, 24@30 deg., $1.05@$1.10 per bbl.

Philadelphia—Aug. 21, 26@28 deg. Baumé, Oklahoma, 90@95c. per bbl.; 30@34 deg., Oklahoma (group 3), 2¼@2½c. per gal.; 16@20 deg. Seaboard, $1.35@$1.50 per bbl.

Cincinnati—Aug. 21, for26@28 deg. Baumé, 5¼s.; Diesel, 28@30 deg. 5½c. per gal.; distillate 38@40 deg., 6c.

Cleveland — Aug. 21, 26@28 deg. Baumé, 4¼c. per gal.

BITUMINOUS COAL

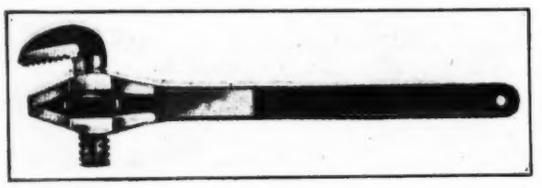
The following table shows the trend of the spot steam market in various coals (mine-run bases, f.o.b. mines):

Coal	Market Quoting	Aug. 14, 1922	Aug. 21, 1922
Pool 1,	New York	.....	.....
Smokeless,	Columbus	$3.50–8.00	$4.50–7.50
Clearfield,	Boston	7.00–9.00	7.00–8.25
Somerset,	Boston	7.75–9.00	7.50–8.50
Kanawha,	Columbus	3.50–7.50	4.50–8.00
Hocking,	Columbus	3.50–8.00	4.50–8.00
Pittsburgh No. 8	Cleveland	7.00–7.50	5.00–7.25
Franklin, Ill.,	Chicago	.....	.....
Central, Ill.,	Chicago	.....	.....
Ind. 4th Vein,	Chicago	.....	.....
West Ky.,	Louisville	3.50–9.00	4.50–7.50
Big Seam,	Birmingham	2.20–5.50	2.50–6.00
S. E. Ky.,	Louisville	3.50–8.00	3.50–7.00

Condensed-Clipping Index of Equipment

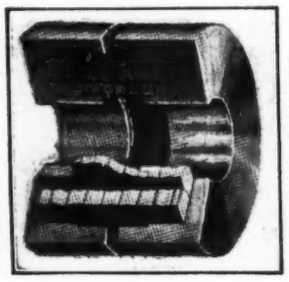
For quick reading and convenient filing. These products have not been described before in "Power."

Wrench, Pipe "Power," 1922.
Greenfield Tap & Die Corp., Greenfield, Mass.



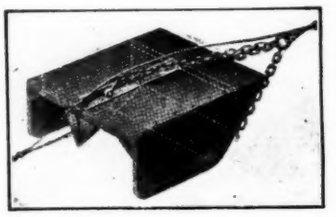
A new pipe wrench bearing the "Little Giant" trade mark. The wrench has the "end-opening" feature familiar to users of machinists' wrenches and is well adapted to use in tight places, since it may be set straight on the pipe like a pair of pliers. It has only three parts, of drop-forged and heat-treated steel. It has a double set of teeth on the main jaw (and in the 14-in. and larger sizes, four sets of teeth, as shown in the cut) and has withstood a torque of 4,700 in.-lb. without slipping or bending.

Coupling, Flexible "Power," 1922.
Steel-Flex Coupling Corp., Detroit, Mich.



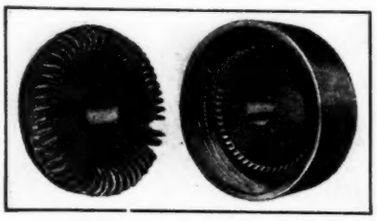
An all-steel flexible shaft coupling in which the drive is taken through helical steel springs formed from square bars of chrome vanadium steel. Two coils are used, one within the other, with their axes coinciding with the axis of the shaft. The coupling will operate with shafts out of line, offset, or when oscillation of either or both shafts is present. The cut shows the coupling for use with small shafting; for heavy duty a flanged type is made.

Scraper, Improved Drag "Power," 1922.
Link-Belt Co., 910 South Michigan Ave., Chicago, Ill.



The Link-Belt "Power Hoe," or drag scraper, is used to store and reclaim run-of-mine and small sizes of coal, sand, gravel, cement and crushed stone. It is dragged back and forth by steel cables over the surface of the storage yard or pile and moves the material to or from the elevator, depending upon whether it is desired to reclaim or store. The scraper fills itself with material and then rides on the surface until discharged; the top plate overcomes any tendency for the scraper to dig in or bury itself.

Coupling, Flexible "Power," 1922.
Electro Metals, Ltd., Kingsway, W. C.



A heavy-duty flexible shaft coupling of English make, consisting of two toothed discs whose teeth engage with the coils of a spiral spring. It is made entirely of steel, is small for the torque it will carry and is suitable for either continuous or reversing drives and for low or high speeds. Eccentricity of shafting is taken up within reasonable limits. The design permits storage of energy in the spring, so that peak torques are absorbed and cyclic vibrations thus damped out.

For a permanent file of new and improved power-plant equipment, clip and paste on 3 x 5-in. cards. (Patented Aug. 20, 1918.)

New Plant Construction

PROPOSED WORK

Ala., Florence—The U. S. Engineer's Office will receive bids until Sept. 18 for furnishing and delivering one 1,000 hp. hydraulic turbine with governor.

Calif., Oakland—The Pacific Gas & Electric Co., 445 Sutter St., San Francisco, plans to build a 1 story transformer house at Temescal Lake. Estimated cost $7,200. Private plans.

Calif., San Francisco—Sherry Bros., 4747 Sutter St., are in the market for a 15 hp. steam boiler.

Calif., Turlock—The Turlock Irrigation District, A. Sorensen, Secy., Bd. Directors, will receive bids until Sept. 3, for furnishing four 1,000 kva. and four 2,000 kva., 66 kv. oil insulated water cooled transformers, 2 out door oil switches and 3 out door air break line switches. R. V. Meikle, Chief Engr.

Calif., Wastley—The Birtschmann Ranch is having plans prepared for building about 8 mi. canals, 3 to 4 ft. wide; enlarging intake channel; 7,900 ft. wood stave pipe line 18 to 30 in.; 3,000 ft. power line, 11,000 volt; main pumping plant including two 12-in. horizontal centrifugal pumps, direct connected to two 250-hp. motors and two 18-ft. suction pipes, 35 ft. long; 1 priming pump; auxiliary pumping plant involving one 8-in. horizontal centrifugal pump, 1,700 lin.ft. 12-in. r.w. stave pipe, one 12-hp. gasoline engine, 1 small priming pump, pump to operate at a 50-ft. head, 880 lin.ft. No. 48 steel flume, 2 ft. 8 in. in dia., etc. Estimated cost $100,000. Easley & Anderson, Antioch, Engrs.

Fla., Marianna—The city plans election Sept. 12 to vote $25,000 bonds for additions to waterworks and electric light plant.

Ga., Atlanta—The Ansley Hotel, C. Dinkler, will receive bids until Aug. 30, for a 125 room addition to the hotel, including mechanical equipment. G. Lloyd Preacher & Co., Healey Bldg., Archts.

Ill., Chicago—V. C. Carlson, 701 Church St., is receiving bids for a 7 story, 140 x 270 ft. hotel including steam heating system on Orrington Ave. and Church St. Estimated cost $1,500,000. J. A. Scanlon, Archt.

Ill., Chicago — I. Gerhardt, Archt., 64 West Randolph St., will soon award contract for a 3-story, 120x240-ft. printing plant on LaSalle St., for the Illinois Publishing & Printing Co., Hearst Bldg. Estimated cost $500,000.

Ill., Chicago—Michaelson & Rognstad, Archts., 3813 West Congress St., is receiving bids for a 5 story, 240 x 240 ft. bank, store and office building, including steam heating system, on Milwaukee Ave. and Irving Pk. Blvd., for E. H. Bengson, 2919 Milwaukee Ave. Estimated cost $500,000. Noted June 31.

Ill., Chicago—M. O'Connor, 144 West Kinzie St., is in the market for an air compressor, belted or direct connected type. (Good size).

Ill., Rogers Park (Chicago P. O.)—O. Van Gunten, Archt., 26 East Huron St., is receiving bids for a 3 story apartment building, including steam heating system. Estimated cost $250,000. Owner's name withheld.

Ill., Chicago—W. Wrigley Jr. Co., 400 North Michigan Ave., is having plans prepared for a 19-story office building. Estimated cost $5,000,000. Graham, Anderson & Probst, 80 East Jackson Blvd., Archts.

Ind., Hammond—The Bd. Pub. Works, A. J. Swanson, Chn., will receive bids until Sept. 15 for furnishing labor, material, tools and appliances for the construction and installation of a complete power piping and steam heating system, in connection with a new pumping station. J. Ericson, 30 North La Salle St., Chicago, Consult. Engr.

Ia., Dubuque—The St. Mary's Convent, 69 Emmett St., is having plans prepared for a 4 story, 225 x 300 ft. convent, including steam heating system. Estimated cost $350,000. Damon, O'Meara & Hills, 1123 Merchants Bank Bldg., St. Paul, Minn., Archts.

Kan., Kansas City—The City Purch. Dept. will receive bids until Sept. 1, for six 1,000 kva., out door type, oil-insulated, self cooled transformers, 60 cycle, single phase, 13,200 volts high voltage, 6600-2300 volts low voltage.

Kan., Lyons—The Bevis Salt Co. is in the market for electric turbines and auxiliary equipment for extensions to plant. Estimated cost $175,000.

Kan., Pittsburgh—The Water Dept, W. J. Lapworth, Supt., is considering the installation of under feed stokers.

La., New Orleans—The Loyolla University, 6363 St. Charles St., plans to build a 4 story, 60x200 ft., first unit of several buildings. Estimated cost $300,000. P. Torre Jr., Rm. 1000. Canal Commercial Bldg., Archt. Total cost about $1,000,000.

Mass., Boston—The Chamber of Commerce, 177 Milk St., will soon award the contract for a 12 story, 113 x 183 ft. office building on Federal and Franklin Sts. Estimated cost $3,000,000. Parker, Thomas & Rice, 110 State St., Archts. French & Hubbard, 88 Pearl St., Engrs.

Mich., Detroit—The city plans to build a 50 x 94 ft. steam heating plant on Byron Ave. Equipment includes, 1 turbo generator set, three 300 hp. boilers, coal hopper, grinder, travelling weigh larry, pivoted belt conveyor, 40 tons per hr. capacity, 3 forced draft under feed stokers, 2 feed pumps 150 gal. per min. against 400 ft. head capacity, in the Herman Kiefer Hospital. A. Kahn, 1000 Marquette Bldg., Engr.

Mich., Grand Haven—Cahill & Douglas, Engrs., 217 West Water St., Milwaukee, is receiving bids for additional equipment, including 3 mechanical stokers and voltage regulators, for the Eagle Ottawa Leather Co., here.

Minn., Detroit—The city, E. J. Bestick, Clk., will receive bids until Aug. 31, for enlarging power station and building new chimney. Estimated cost $28,000. L. P. Wolff, 1000 Guardian Bldg., St. Paul, Engr. Noted May 2.

Minn., Royalton—The city will receive bids until Sept. 1, for deep well pump machinery for waterworks system. R. E. Borrowman, St. Cloud, Engr.

Mo., Diamond—H. Bowman is in the market for a 10 hp. engine.

Mo., Kennett—The Caruthersville Light & Power Co., plans extensions and improvements to local power plant. Estimated cost $40,000. Engineer not announced.

Mo., St. Joseph—The Aunt Jemima Mills Co., 2nd and Edmund Sts., is in the market for an air compressor with belt and motor equipment.

Neb., Columbus — The city will soon award the contract for additions and improvements to waterworks, including a 250,000 gal. tank on a 120 ft. balcony, installing pipes and fittings, resetting pumps, construction of power house, etc. Estimated cost $31,882. Henningson Engr. Co., National Bldg., Omaha, Engrs.

Neb., McCook—Chicago, Burlington & Quincy R.R., 547 West Jackson Blvd., Chicago, Ill., F. T. Darrow, Asst. Ch. Engr., Lincoln, will soon receive bids for a 2 story 40x65 ft. power plant, including 7x185 ft. concrete stack. Estimated cost $85,000.

Nev., Sparks—I. G. Wagner is in the market for refrigeration and ice making machinery for proposed plant at Marysville, Calif.

N. J., Asbury Park—The Asbury Park Hotel, c/o Warren & Wetmore, Archts., 16 East 47th St., New York, will soon award the contract for a 6 story hotel, here.

N. Y., Bolivar—The Bolivar-Richburg Electric Co. plans an electric light system here and in Richburg and extending transmission lines to Wirt and Genesee. Estimated cost $30,000.

N. Y., Brooklyn—The Brooklyn Edison Co., 560 Pearl St., is having plans prepared for a 400,000 kw. power plant at Marshall St. and Hudson Ave. Private plans. Foundation awarded to Frederick Snare, Inc., 8 West 40th St., New York, about $1,000,000.

N. Y., Cohoes—C. L. Cadle, Supt. Pub. Works, Capitol, Albany, will receive bids until Sept. 6 for the construction of a power house at Cresent Dam, here.

N. Y., New York—The Dept. of Police, R. E. Enrright, Comn., 240 Centre St., will receive bids until Sept. 1, for furnishing and installing a low pressure c.i. sectional, header type, steam boiler at the repair shop, 205 Mulberry St., Manhattan.

Ohio, Cleveland—The Bd. Educ., F. G. Hogen, Dir., East 6th St. and Rockwell Ave., will receive bids until Sept. 18, for a 3 story, 250 x 300 ft. high school including steam heating plant on East 152nd St. and St. Clair Ave. Estimated cost $2,000,000. W. R. McCornack, c/o owner, Archt. Noted Nov. 1, 1921.

Ohio, Cleveland—The Commercial Forging Co., 3709 East 91st St., is in the market for 125 to 150 hp. Economic type boiler, 110 lbs. rating.

Ohio, Cleveland—The Crucible Steel Castings Co., c/o H. T. Tietk, Champlain Ave. and Canal Rd., is in the market for a 5 ton electric crane, sand blast equipment, cupola and motors for new plant.

Ohio, Cleveland—B. Koslen, 10612 Olivet Ave., plans to build two 4 story apartment buildings, including steam heating system, on East 85th St. Estimated cost $250,000. M. Weis, Union Bldg., Archt.

Ohio, East Columbus—The Amicon Fruit Co., 81 East Naghten St., is in the market for machinery and equipment for a 3 story cold storage and refrigeration plant at Williamson, W. Va.

Ohio, East Youngstown (Youngstown P. O.)—Mahoning Valley Water Co., 403 Mahoning Bank Bldg., plans to build a new booster station to supply additional water to large mills. Estimated cost $15,000. T. Evans, Supt. Engineer not announced.

Ohio, Findlay—The Bd. Educ. will vote on $325,000 bonds for a modern centralized school.

Ohio, Lakewood (Cleveland P. O.)—The Bd. Educ., G. W. Grill, Clk., Warren Rd., plans to build a 2 story grade school, including steam heating system, on Clifton Blvd. Estimated cost $300,000. C. W. Hopkinson, Rose Bldg., Cleveland, Archt.

Ohio, Lancaster—The Lancaster Lens Co. is in the market for an air compressor.

Ohio, Marion—The city will receive bids until Aug. 31, for sewage disposal plant and sewer system, including sewer line, grit chambers, settling tanks, pumping station, dosing tanks, buckling filters, sludge beds, etc. Estimated cost $450,000. G. B. Jascoigne, 648 Leader-News Bldg., Cleveland, Engr.

Okla., Tulsa—Bd. of Educ. plans to build a 4 story 125 x 160 ft. school including a swimming pool and refrigerating plant, on 6th and Cincinnati Sts. Estimated cost $1,000,000. W. E. Gillham, 309 Mutual Bldg., Kansas City, Mo., Engr. G. Winkler, 444 Palace Bldg., Tulsa, Archt.

Pa., Ebensburg—The Cambria County Comrs. plan to build a 3 story, 120x200 ft. hospital on Little Farm including water and heating plants and sewage system. Estimated cost $250,000. Architect not selected.

Pa., Phila.—The city, J. A. Vogelson, Engr., City Hall, will receive bids until Sept. 7, for a sewerage disposal plant, including 4 electric driven pumps, capacity 35,000 gal. per min., electrical equipment, 4 motors, 76 and 60 hp. and 2,250 hp.

Pa., Phila.—J. T. Hoekstra, Archt., 1713 Sansom St., is receiving bids for 4 one story, 96 x 182 ft. buildings for an ice manufacturing plant at 10th and Windrim Sts., for the Logan Ice Co. Estimated cost $150,000.

Pa., Stroudsburg—The Pocono Food Products Co., First St., is in the market for refrigeration machinery and equipment for large refrigerator and fruit storage plant now under construction.

Pa., York — The York Haven Water & Power Co. plans to expend $1,500,000 for improvements during the next 5 years to consist of 20 or more generating units, the first to be installed to cost about $60,000.

S. D., Hot Springs—The Hot Springs Water Light & Power Co., B. W. Wattles, Gen. Supt., plans to rebuild power plant, which was totally destroyed by a flood. Capacity 2 generators, 450 kw., 3 phase, 60 cycle a.c., 100 hp. boilers, one 340 hp. water wheel. Hollister Engr. Co., Bankers Life Bldg., Lincoln, Neb., Engrs.

Tex., Clifton—The Attorney General's Dept., Austin, approved $20,000 bonds for waterworks and $35,000 for electric light improvements. Address Mayor, Clifton.

Tex., Dallas—H. J. Johnson, 508 N. Texas Bldg., is in the market for a 35 to 75 hp. gas engine.

Tex., San Antonio—The State Bd. of Control, Austin, will receive bids until Sept. 2 for complete heating mains for the Southwestern Insane Asylum. J. P. Greenwood, Consult. Engr.

Wis., Glidden—The Glidden Telephone Co., plans to make extensions and improvements to telephone property, including transmission line. Estimated cost $36,000. Engineer not selected.

Wis., Hartford—The Kissel Motor Car Co. will build a 40x60 ft. power house. Estimated cost $20,000. Owner is receiving bids on steel work and will also purchase a feed water heater. Contract for brick chimney awarded to the Alphons Custodis Chimney Const. Co., 140 South Dearborn St., Chicago. Cahill & Douglas, 217 West Water St., Milwaukee, Engrs.

Wis., Ladysmith—The city, C. C. Kile, Clk., plans to build a 1 story, 60 x 70 ft. central heating plant and auxiliary pumping station. Estimated cost $60,000. Architect not selected. A steam pump, several boilers, etc., will be installed.

Wis., Milwaukee—The Milwaukee Elec. Ry. & Light Co., c/o J. Anderson, Plant Engr., 2nd and Sycamore Sts., plans to build a boiler house at Lakeside. Estimated cost $1,000,000. R. H. Pinkley, c/o owner, Engr.

Wis., Racine — The New Racine Hotel Co., and W. E. Perry, and Fugard & Knapp, Archts., 212 East Superior St., Chicago, will receive bids until Sept. 15 for the first unit of a 7 and 8 story, 100 x 120 ft. hotel, on 6th and Main Sts.

Wis., Racine—The Racine Pure Milk Co., 1010 13th St., is having surveys made for improvements to power plant. Cahill & Douglas, 217 West Water St., Milwaukee, Engrs. New boilers and generating equipment will be installed.

Wis., Shawano—Shawano County, O. O. Wiegand, Clk., will receive bids until Sept. 2 for a central heating plant, including boilers and heating installation. Estimated cost $15,000. W. E. Reynolds, 109 South 11th St., Green Bay, Archt.

Ont., Brockville—The town council, G. K. Dewey, Clk., voted a by-law for $5,800 and will soon receive bids for the reconstruction of the pumping machinery.

Ont., Byng Inlet—Graves Bigwood Lumber Co., plans to re-equip power house and planing mills damaged by fire and lightning to extent of $100,000, and want prices on machinery.

Ont., Hamilton—The Ontario Hydro Comn., 190 University Ave., Toronto, Sir Adam Beck, Chn., London, are having plans prepared for extension of power lines along Beach Rd. and will receive bids about Aug. 26 for new hydro station. Prices wanted on wiring and equipment. Estimated cost $40,000.

Ont., London—Watt & Blackwell, Engrs., Bank of Toronto Bldg., will receive bids until Aug. 31, for new boiler house and laundry for the St. Josephs Hospital. Estimated cost $40,000. Prices wanted on new 100 hp. boiler, additional radiation and complete modern laundry machinery.

Ont., Port Dover—The town, J. S. Martin, Reeve, will receive bids until Sept. 8 for 7 mi. 6 and 8 in. c.i. pipe, 140 hydrants, pump house, 2 centrifugal pumps, 1 gasoline the other electrically driven, 200,000 gal. standpipe 150 ft. high. Estimated cost $60,000. Noted Apr. 11.

Ont., Prairie Siding—County Council, A. Kent, Chatham, want prices on equipment for drainage pumping system, including pump house, pumps, and portion of equipment destroyed by fire. Estimated cost $28,000. J. Gosnell, County Bldgs., Chatham, Engr.

Ont., Queenstown—Hydro Electric Power Comn. of Ontario, University Ave., Toronto, Sir Adam Beck, Chn., plan a new 80 ft. canal, about 20 mi. long, capacity 20,000 cu.ft. per sec., from Niagara Falls to Queenstown, capable of generating 1,000,000 additional hp. Estimated cost $100,000,000. F. A. Gaby, Ch. Engr.

Ont., Toronto—The city, R. C. Harris, Ch. Engr. and Comr. of Wks., City Hall, plans to build a pumping station including intake, pumphouse, filterhouse, filters, pumps, etc., capacity 40,000,000 to 60,000,000 gals. per day. Estimated cost $2,500,000.

Ont., Toronto—The Hydro Electric Power Comn., 190 University Ave., is receiving bids for three 86,000 hp. hydraulic turbines, 320 ft. head, for the Queenston plant. Estimated cost $1,000,000. F. A. Gaby, c/o owner, Ch. Engr.

Ont., Yarmouth—The Township Council, W. C. Caughell, Clk., 386 Talbot St., St. Thomas, plans an electric lighting and power distribution system. Estimated cost $28,000. Estimates wanted on substation and electric power lines to supply the township.

Que., Montreal—The Burton Brewery Co. of Canada, Ltd., B. H. Anglin, Pres., plans to build a 3 story, 100 x 300 ft. brewery at St. Denis and De Valier Sts. Estimated cost $400,000.

CONTRACTS AWARDED

Calif., San Francisco—The city and county of San Francisco awarded the contract for transformers, switchboards and accessory equipment, for Moccasin Creek power plant under Contract No. 81, Propositions A-1 and D-1, to the Westinghouse Elec. and Mfg. Co., First Nat'l Bank Bldg., total $379,585. Noted Aug. 22.

Calif., San Francisco—The Crest View Apts., Inc., c/o J. L. Stewart, Archt., Claus Spreckels Bldg., awarded the contract for an 8-story apartment building on Gough and Washington Sts., to Monson Bros., 251 Kearney St., $400,000.

Calif., Santa Rosa—The city awarded the contract for constructing air lift for artesian well, aerator, flume, receiving reservoir, capacity 350,000 gal., pumps and pump houses, compressors, motors, crane, meters, electrical machinery, etc., to the Butte Electrical Equip. Co., 530 Folsom St., San Francisco, about $46,000. Noted Aug. 15.

Calif., Turlock—The Turlock Irrigation District awarded contracts for a transmission line as follows: 200 steel towers to Pacific Coast Steel Co., Rialto Bldg., San Francisco, $110.00 each. 470 miles wire to Aluminum Co., of Amer., Rialto Bldg., San Francisco, $2.47 each, bushings to Ohio Brass Co., Hobart Bldg., San Francisco, and switchboards to Genl. Electric Co., Rialto Bldg., San Francisco, $18,250. Noted Aug. 22.

Ill., Chicago—The James T. Igoe Co., 117 W. Harrison St., awarded the contract for a 10 story, 100 x 150 ft. printing plant, on Van Buren and Jefferson Sts., to the E. P. Straudberg Co., 236 East Erie St. Estimated cost $750,000. Steam heating system will be installed. Noted May 21.

Ill., Chicago—Kahn & Jones, c/o A. S. Alschuler, Archt., 58 East Jackson Blvd., awarded the contract for three 3 story, 158 x 250 ft. apartment buildings, on Inglenside Ave. and 54th St., to the Johnson-Anderson Co., 7120 Evans Ave. Estimated cost $450,000. Steam heating system will be installed. Noted May 2.

Kan., Emporia—S. M. Parker, Wichita, will build a 3 story, 130x150 ft. hotel here by day labor. Estimated cost $200,000. Geo. H. Siedhoff Const. Co., 126 East 1st St., Wichita, Archts.

Mass., Revere—The city awarded the contract for a 4 story, 75 x 132 ft. high school, including steam heating and ventilating systems, on Beach St., to A. B. Carter & Sons Co., 73 Tremont St., Boston. Estimated cost $250,000.

Mich., Detroit—J. B. Book, Book Bldg., awarded the contract for furnishing and erecting the structural steel frame of a 21 story, 60 x 100 ft. office building on Washington Blvd., to the Russel Wheel & Foundry Co., Chene St. and Belt Line Ry.

N. J., Jersey City—The Standard Milling Co., 49 Wall St., New York, awarded the contract for a 6 story warehouse on Pavonia Ave. here, to the Lynch Constr. Co., 52 Vanderbilt Ave., New York. Estimated cost $2,000,000.

N. Y., Brooklyn—The Zoe Cla Construction Co., c/o C. B. Meyers, Archt., 31 Union Sq., New York, will build a 9 story, 120x150 ft. apartment on Ocean Ave., here, by day labor. Estimated cost $700,000.

N. Y., New York—The 47 West 81st St. Corp., 345 Madison Ave., awarded the contract for a 15-story hotel at 41 West 81st St., to J. G. Siegel, 343 Madison Ave. Estimated cost $750,000. Steam heating system will be installed.

N. Y., New York—The 150 East 73rd St. Corp., 403 Madison Ave., awarded the contract for an 11 story apartment on East 73rd St. to J. Lowry, Jr., 171 Madison Ave. Estimated cost $1,250,000. Steam heating system will be installed.

N. D., Walhalla—The city awarded the contract for a water works system including 5,800 ft. of 6 in. c.i. pipe, well, pump station and elevated tank, to J. T. Kennedy, Grand Forks, N. D. $26,394.

Ohio, Dayton—The Delco Light Co., G. B. McCann, Secy., North Taylor St., awarded the contract for a 6 story, 190 x 350 ft. electrical apparatus factory on East 1st St., to the H. K. Ferguson Co., 6523 Euclid Ave., Cleveland, about $600,000.

Pa., Phila.—Fischers Dairy, Orthodox and Worth Sts., awarded the contract for a 2 story, 40 x 61 ft. dairy, a 2 story, 52 x 54 ft. stable and a 16 x 31 ft. power house, to H. Gill, Jr., 2514 Germantown Ave.

Pa., Phila.—The Westinghouse Electric Co., Weidner Bldg., awarded the contract for a 10 story, 95x111 ft. office and sales building on 30th and Walnut Sts. to Hughes-Folkrod Co., Commonwealth Bldg.

Pa., Pittsburgh—The Bd. Educ., Fulton Bldg., awarded the contracts for a 2 story addition to school on Hazelwood Ave., to Pittsburgh Engr. & Const. Co., Homewood Ave., $151,805; heating to the Ryan Heating Co., $23,645. Noted May 16.

Wis., Hawkins—The Hawkins Elec. Light & Power Co. will build a 34 x 152 ft. power plant by day labor. Equipment includes two 65 hp. oil engines, generator oil reserve tank and power machinery. Estimated cost $40,000. Private plans.

Wis., Milwaukee—The Milwaukee Elec. Ry. & Light Co., 22nd and Sycamore Sts., will build a 40x50 ft. addition to substation on Oakland Ave., by day labor. R. H. Pinkley, c/o owner, Engr. Contract for equipment awarded to the General Electric Company.

Wis., Milwaukee—The Seaman Body Corp., 1732 Richard St., awarded the contract for a 5 story, 100x225 ft. and 100x 420 ft. factory for the manufacture of automobile bodies, to Theo. Stark & Co., 130 Muskego Ave. Estimated cost $350,000. Noted Aug. 22.

B. C., Chilliwack—The city awarded the contract for small pumping station and the supplying and laying of about 6000 ft. of 6 to 12-in. concrete pipe, to Hodgson, King & Marble, 626 Pender St. W., Vancouver, $23,924. Contract for pumps will be awarded later.

B. C., Ocean Falls—Pacific Mills, Ltd., 510 Hastings St., W., Vancouver, awarded the contract for raising the height of existing dam 15 ft. at Linke Lake near here, used for power purposes at paper mills, to Robertson & Rendell, 504 Credit Foncier Bldg., Vancouver. Noted July 11.

B. C., Prince Rupert—The Province of B. C. awarded the contract for a 2 story, 56x159 ft. court house, to McDougall & McNeill. Estimated cost $400,000. A steam vacuum system and 2 return tubular boilers will be installed.

B. C., Vancouver—The B. C. Electric Ry. Co. have had plans prepared for the construction of a dam at Stave Falls, 640 ft. long and about 50 ft. high, including sluice, gates, etc., also raising of present dam. Estimated cost $900,000. J. G. Newell, c/o owners, Engr. Work will be done by day labor.

B. C., Vancouver—The Dominion Government, Ottawa, Ont., awarded the contract for a grain drying plant consisting of a 1 story, 30x75 ft. boiler house, and a 30x60 ft. drying plant 90 ft. high, at the Government Elevator, to Barnet, McQueen & Co., Ltd., Fort William. $85,000.

Ont., Toronto—The City awarded the contract for an oil heating system for the new civic arena at Exhibition Park, to Purdy Mansell, Ltd., 63 Albert St., $130,000.

Que., Montreal—Ross & MacDonald, Archts., 1 Belmont St., awarded the contract for a 10 story, 79x150 ft. office building on Sherbrooke St. for the Medical Art Bldg. Corp., Ltd., to the Foundation Co., Ltd., St. Catherine St. W., $600,000.